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MFR PAPER 1259

Development of an Aquacultural Program for Rehabilitation of Damaged Oyster Reefs in Mississippi

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ABSTRACT—A rehabilitation program was developed for damaged oyster (Crassostrea virginica) *reefs in Mississippi Sound in which new equipment will be employed to: 1) transplant oysters from polluted to clean reefs; 2) wash a mud deposit off a formerly productive reef; and 3) return buried shells to the surface of reefs for oyster spat collection. The Mississippi oyster has extremely high productive potential and ecological conditions for oysters on some reefs are normally excellent. Aspects of functional operations, economics, and sociology of the oyster industry are examined and described. After the program is completed, the oyster industry should return to its status of the 1960's when annual production averaged 160,000 barrels (640,000 bushels) of oysters.*

INTRODUCTION

Production of the oyster *(Crassostrea virginica)* from reefs in Mississippi Sound declined sharply in the early 1970's by comparison with the decade of the 1960's when annual landings averaged about 160,000 barrels[1]. In 1974-75, production was only a fraction of that level, and only 5 percent of oysters processed in Mississippi were harvested from her own reefs; the remainder came from Louisiana. The decline resulted from: 1) physical damage to reefs and, temporarily, to vessels and processing factories and shops, by Hurricane Camille in August 1969; 2) adverse salinities that were periodically too high in 1972 and too low in 1973-74; and 3) reef closures due to pollution in the 1960's (Demoran, 1972; Gunter, 1975).

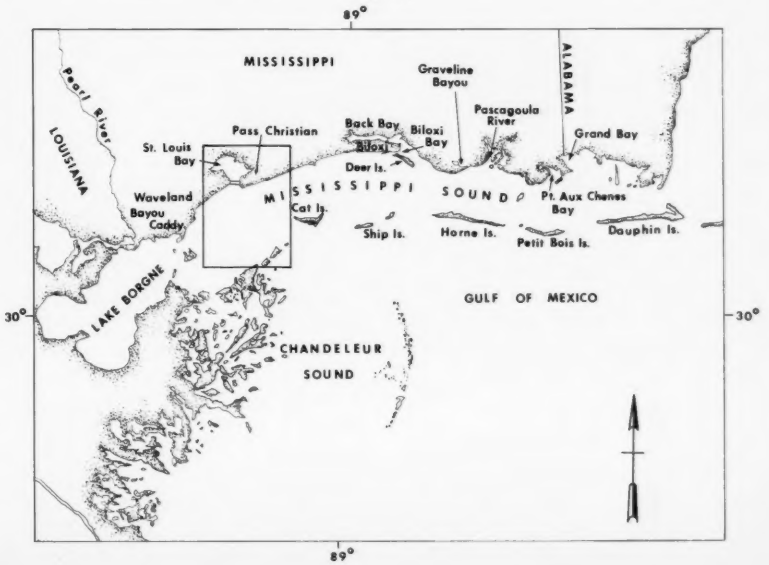
In 1975, tonging and dredging reefs off Pass Christian, the largest and most productive in the Sound, were poorly stocked and physically unsuitable for producing many oysters for the first time since the modern oyster industry began in the late 1800's. Thus, Mississippi oyster production was low in 1975-76, and undoubtedly cannot rise again to levels of the 1960's unless some reef rehabilitation measures are undertaken. If the combination of environmental circumstances that damaged the reefs does not reoccur, a single successful rehabilitation effort will probably be long lasting.

INVESTIGATION OBJECTIVES

Through an agreement with the National Marine Fisheries Service, the Mississippi Marine Conservation Commission gave me the assignment of identifying the potential of that State's oyster resources, recommending a program and, if feasible, introducing new methods to rehabilitate damaged oyster reefs to conserve the oyster resource and restore oyster production and the industry. The working program was to be simple in structure and inexpensive, but extensive in area.

During the investigative period that lasted for 5 weeks, from 5 July to 1 August, and 27-31 October 1975, information was gathered on: 1) status and needs within the oyster industry; 2) potential oyster productivity and reef ecology; 3) existing oyster stocks on reefs; and 4) constraints that limit oyster reef productivity. New aquacultural

Figure 1.—Mississippi coast showing principal areas mentioned in text, with inset showing Pass Christian area (Fig. 2).



[1]A Mississippi barrel = 4 U.S. bushels or 1.4 hectoliters.

equipment was constructed and tested. The information presented in this report was derived from the literature, from interviews with oystermen and processors, and from direct observations and testing. Scuba gear was employed extensively in evaluating conditions of reefs, oyster densities, and new aquacultural equipment.

BACKGROUND

Physical Aspects of Mississippi Sound

Mississippi Sound (Fig. 1) lies off the State's southern coast which runs in an east-west direction for about 68.8 miles (110 km). It terminates in the Louisiana marshes and Lake Borgne in the west and Alabama in the east. It is bounded offshore by an extension of the Louisiana marshes, and Cat, Ship, Horne, and Petit Bois Islands. These are from 3 to 8 miles (5 to 13 km) wide, with shallow passes between them, and they run parallel to and 8 to 12 miles (13 to 19 km) from the coast. There are also several smaller islands off Biloxi Bay and the Pascagoula River mouth. Collectively, these islands protect the Sound and coast from heavy southerly storms. They also slow intermixing of Sound water with its characteristically high nutrient levels, dense plankton blooms, and large oyster larval concentrations with less rich Gulf of Mexico water.

Thus, the Sound has a rich biota, including oysters, shrimp, and fish. Depths are mostly 9-13 feet (2.7-4 m) at mean low water; the rise and fall of tide is about 2 feet (0.6 m). Several rivers with combined drainage areas of nearly 40,000 square miles (104,000 km^2) discharge into the Sound; these, along with contributions from Lake Pontchartrain and Lake Borgne, maintain brackish waters especially at the western end of the Sound and near the coast (Christmas, 1973). The bottom consists of either mud, fine sand, or hard shell and oyster reefs.

Locations of Oyster Reefs

The largest productive oyster reefs extend off Pass Christian within 3 miles (5 km) of shore and are named the Pass Christian Tonging Reef and Pass Christian (Henderson Point) Dredging Reef (Fig. 2). There is a large reef in Biloxi Bay, small ones in Back Bay of Biloxi, two large reefs (Gautier Reef and Pascagoula Reef) in the Pascagoula River mouth, and various smaller reefs in Bayou Caddy, Waveland, St. Louis Bay, Graveline Bayou, Pt. Aux Chenes Bay, and Grand Bay (Fig. 1).

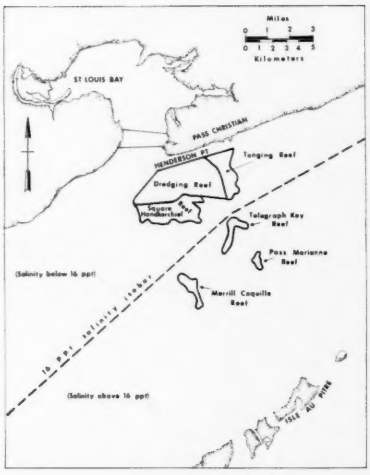


Figure 2.—Pass Christian area showing location of principal oyster reefs and usual position of 16-ppt salinity isobar.

Gunter (1975) stated that oysters were harvested from as many as 7,500 acres (3,000 hectares) during good years, and about 2,500 acres (1,000 hectares) during poor years before 1969. He also described old mud-covered reefs that had oysters hundreds of years ago, and naked reefs where oysters died when the Mississippi River was leveed south of New Orleans. The naked reefs are between 3 and 7 miles (5 and 11 km) south of Pass Christian, and are named Pass Marianne Reef, Telegraph Key Reef, and Merrill Coquille Reef, among others (Fig. 2). They produce oysters, but most inshore oysters die if low salinities caused by flood waters endure for a lengthy period, a condition which occurs about once every 10 years. Every year, they collect an oyster set which normally is killed later by predators and diseases. Gunter and Demoran (1970) stated that these reefs lie on 21-foot (6.4-m) deposits of shells about 7,000 years old at the bottom. Demoran (1966) stated that the Pass Christian reefs constitute one of the largest nearly continuous oyster reefs in the world.

Effect of Leveeing the Mississippi River

The effect of leveeing the Mississippi River and construction of the Bonnet Carre Spillway on oyster reefs in Mississippi Sound has been reviewed in various articles (Gunter, 1952, 1953, 1975). The heyday of oystering in Mississippi was from 1880-1940 when the Mississippi River had low levees or none south of New Orleans. From historical times until 1940, the Mississippi River discharged its water over a wide arc-like or triangular area, with the main flow at the mouth into the open Gulf and a lesser quantity of fresh water toward the ends of the arc into the bays of Louisiana and Mississippi Sound. This subjected the oyster reefs of Louisiana and Mississippi to a seasonal decrease in salinity during the first half of the year. Leveeing of the river funnelled water out of the river's mouth in greater volume, causing the bays and Mississippi Sound to get significantly less fresh water and nutrients. Therefore, their salinities are higher, and the original oyster zone in both Louisiana and Mississippi is significantly smaller.

In 1932, the Bonnet Carre Spillway was constructed 24 miles (39 km) above New Orleans to protect that city from floods. Whenever flood waters endanger it, the spillway is opened by the U.S. Army Corps of Engineers. The flood waters empty into Lake Pontchartrain and thence into Lake Borgne and Mississippi Sound. Most flood waters flow through Cat Island Channel into Chandeleur Sound and then into the Gulf of Mexico. Thus, the fresh water significantly affects only that part of Mississippi Sound lying west of a line from Cat Island to Pass Christian. In the 4 years of great spillway discharges since it was built, namely 1937, 1945, 1950, and 1973, nearly 100 percent of oysters in Mississippi Sound west of St. Louis Bay have been killed. East of that line to Pass Christian, mortality was about 50 percent.

The effect of the spillway has been

influenced by several factors. If the discharge is fast, fresh water impinges on reefs for only a short period with no oyster mortality. If the spillway waters come early in the spring, when condition of oysters is good and temperatures are low, mortality is lower than in summer. Spillway discharges kill most conches, disease organisms, and other pests, and also add tons of nutrients to the area. Nonetheless, the spring flood season is a critical one for Mississippi oysters. Butler (1949) reported that 50-100 percent of the oysters were killed in areas west of Pass Christian following the 1945 spillway opening during a flood.

Recently, there has been interest in Louisiana and Mississippi in a Federally controlled program to open periodically the Bonnet Carre Spillway to add some control structures south of New Orleans because of the great negative effect of the Mississippi levees. This would divert some water which empties directly into the Gulf of Mexico towards Louisiana bays and Mississippi Sound, and result in larger areas for oyster production free of conches and disease along with greater abundance of fish and bird life, especially during droughts (Etzold and Williams[2]).

Historical Oyster Landings

A glance at oyster landings from Mississippi reveals they were consistently high from the late 1800's until 1940 when they averaged about 265,000 barrels annually (Lyles, 1969). During World War II, 1941-45, the oyster reefs were unregulated and overfished making them permanently less productive (Gunter, 1975). Accordingly, oyster landings through the next two decades (through 1959) averaged only 32,000 barrels (Lyles, 1969). In 1960, landings turned sharply upward because the Mississippi Marine Conservation Commission supported a program, which, under the direction of William J. Demoran, increased productivity of several reefs through a shell and oyster seed planting program. Thus, in the 1960's, annual landings averaged 160,000 barrels, or five times greater than in the previous two decades (Lyles, 1969; Gunter and Demoran, 1971; Demoran, 1972; Christmas, 1973; and Gunter, 1975). In the 1970's landings declined sharply following the 1969 hurricane, and only 15,000 barrels were landed in 1974 following the great flood of 1973.

Effect of Channel Dredging

A large oyster reef between Biloxi and Deer Island was permanently removed when the natural existing channel was deepened in the 1960's.

Impact of Hurricanes

The hurricane season is a critical one for Mississippi oyster populations. The various hurricanes that have struck the Mississippi coast have each damaged oyster reefs and the industry. Engle (1948) reported that some oysters were killed, boats damaged or lost, and processing factories and shops damaged or destroyed. He recommended that productivity of the reefs be restored by spreading seed oysters and shells over them. Engle (1948) observed that the Square Handkerchief Reef (Fig. 2) off Pass Christian, a famous reef that once produced large quantities of oysters, contained oysters in 1974. It produced up to 1969. However, it was barren in 1975. The reef was damaged by hurricane Camille in 1969 and completely destroyed by the flood of 1973.

Hurricane Camille in August 1969 with winds of about 200 miles per hour (89 m/sec) was the most severe hurricane on record to strike the Mississippi coast. The tide level was above normal when the hurricane struck, and consequently most reefs were not severely damaged. Nevertheless, I found that the hurricane covered the Pass Christian (Henderson Point) Dredging Reef with mud, and it damaged oyster boats, factories and shops. Ford (1970) stated that it damaged some oyster reefs in Louisiana by covering them with mud and marsh grass.

Effect of Pollution

As a consequence of human population growth in southern Mississippi (Cross et al., 1974), various bays and the coastal zones within a mile of the mainland coast of the Sound have become contaminated by sewage pollution. Accordingly, the Mississippi Health Department closed several oyster reefs temporarily pending a reduction in pollution. In 1961, the reef in the Pascagoula River mouth was closed and resulted in an 80,000 barrel loss in 1962 landings. In 1967, the reef in Biloxi Bay, which had supported more than 75 tonging boats, was also closed (Demoran, 1972). During 1975, the reefs in St. Louis Bay and Graveline Bayou were closed, and those sections of oyster reefs within a mile of the Pass Christian shore had been closed already. Currently, the major oyster reefs in Mississippi Sound off Pass Christian and smaller ones to the west remain pollution-free and open for oyster harvesting. These are likely to remain open because of their distance from heavily populated zones.

Reef closures due to pollution have had economic and personal consequences. Oystermen have been the first and most severely affected, direct victims of pollution, a condition they did not create. It is a blow when a great reef that produced oysters for a number of human generations is closed. Men desire to work those reefs, in part, because they earned their livelihood from them, and, in part, for sentimental reasons because their immediate family and forebears did so. Closures have been particularly hard on elderly men who normally benefit greatly by tonging oysters with other fishermen in sheltered bayous.

PRODUCTIVITY OF OYSTERS

Some features of oyster biology were reviewed and surveyed to estimate the potential productivity of Mississippi oysters.

Spat Recruitment

Mississippi oysters have high reproductive capacity since they spawn and set prolifically over a 5- to 6-month

[2]Etzold, D. J., and D. C. Williams, Jr. 1974. Data relative to the introduction of supplemental fresh water under periodic controlled conditions for the purpose of enhancing seafood productivity in Mississippi and Louisiana estuaries. Unpubl. rep., 41 p. Mississippi-Alabama Sea Grant Consortium.

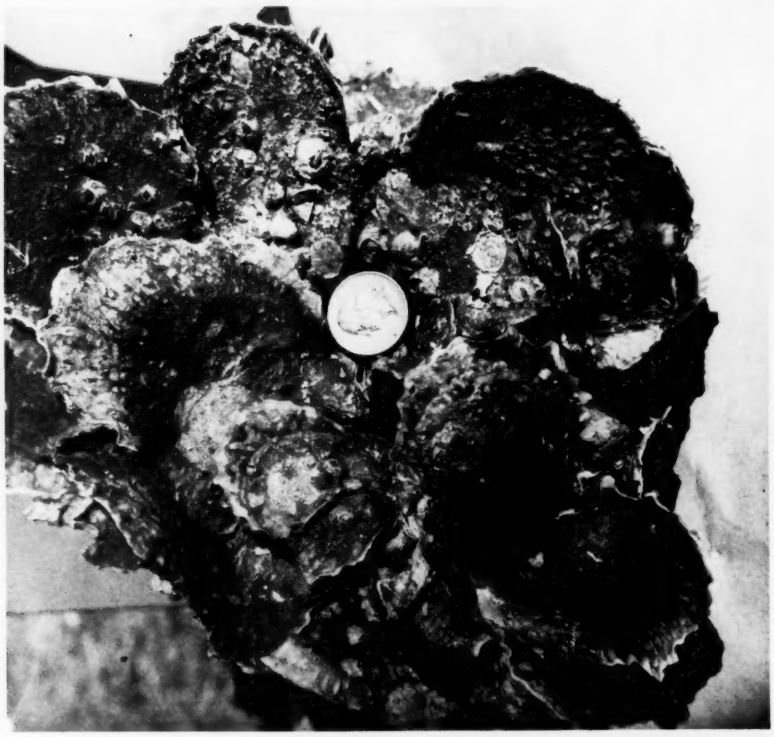


Figure 3.—A cluster of oysters consisting of spat and older year classes of oysters from a reef near Pass Christian.

period (from May to October) virtually every year (Hopkins, 1954; Demoran, 1966; Gunter and Demoran, 1971). Usually the greatest set occurs during June with a smaller wave in September (Gunter and Demoran, 1971). I observed two to four year classes of oysters (Fig. 3) on reefs from St. Louis Bay to the Pascagoula River mouth in July 1975, illustrating that setting is widespread. Annual spat recruitment has always been sufficiently intense to support significant commercial harvests of adult oysters on those reefs with favorable ecological conditions.

Growth Rate

Usually, Mississippi oysters grow to a length of more than 3 inches (76 mm) in less than 2 years (Gunter and Demoran, 1971; Maghan, 1967). Growth proceeds throughout the year as in Florida (Ingle and Dawson, 1952). My data on spat sizes on the Pass Christian tonging reef between summer and fall 1975 reveal excellent growth. In mid-July, spat averaged 0.3 inches (8.5 mm) long (range, 0.1 to 0.5 inches, 2.5 to 13 mm), and in late October, they averaged 1.2 inches (30 mm) long (range, 0.3 to 2.0 inches, 5 to 50 mm); an average increase of about 0.9 inches (23 mm) in 3.5 months.

Survival Rate

Survival of oysters until market size is high on inshore reefs during typical years when salinities are within a satisfactory range. Gunter (1953) estimated that normal survival for adult oysters is from 96 to 98 percent per month. Most oysters larger than an inch (2.5 cm) were alive on various reefs in July and October 1975.

In western Mississippi Sound oysters are susceptible to mortality from fresh water influxes, but recovery from the low-salinity condition can be rapid when rivers cease their flooding and prevailing winds are southerly (Butler and Engle, 1950). Sudden severe drops in salinity can kill oysters. For instance, in 1962 a heavy rain which resulted in virtually fresh water at the Pascagoula River mouth for a long period killed nearly 100 percent of the oysters on Pascagoula Reef (Christmas, 1973). Oysters can survive in a salinity as low as 2 ppt for about a month at low temperatures and can even survive in fresh water for a few days. The incidence of oyster mortality caused by low salinity is related to both water temperature and condition of the oyster (Gunter, 1953). However, the duration of exposure to fresh water is the most important factor in mortality (Butler, 1952).

In dry years, increased salinities over inshore reefs enable the conch to invade and prey on oysters (Gunter et al., 1974). In 1956, conches killed more than half the oysters on some Pass Christian reefs (Chapman, 1958). An adult conch can consume nearly 90 one-week old spat per day, and one adult oyster per 2 days (Butler, 1954a). Periods of high salinity coupled with high temperature may result in mass oyster mortality by the fungus *Labyrinthomyxa marina* (Mackin, 1951). Gunter et al. (1974) estimated that this fungus may be responsible for oyster mortality levels of 50-60 percent during such periods.

Hopkins (1954) stated that oysters can thrive in undiluted seawater, provided enemies are not present. However, survival of oysters to market size on offshore Pass Christian reefs where salinities are normally 20-24 ppt (Christmas, 1973) is virtually zero in normal years due to presence of conches and molluscan diseases.

I noted that crabs, probably blue crabs, which occur on all reefs regardless of salinity (Christmas and Langley, 1973), had killed many spat averaging about 1 inch (2.5 cm) on the Pass Christian reefs between July and October 1975. Under Laboratory conditions, a blue crab can consume as many as 19 spat per day (Menzel and Hopkins, 1956).

The actual extent of oyster mortality caused by each agent has never been determined. Thus, whenever oysters die on offshore Pass Christian reefs, the relative significance of each predator

and disease effect is unknown, but the fact of overall death on these reefs during high salinity periods is well known.

ECOLOGY OF REEFS

The distribution and abundance of oysters in Mississippi Sound depend on several features, especially salinity, distribution of various animals, and nature of bottom substrata. There are some negative influences of the environment which suppress the productive potential of oysters. These together with other ecological features are treated in this section.

Salinity and Temperature Regimes

Salinities vary seasonally. They are lowest in March-April when normally a 16-ppt isobar lies about 1 mile (1.6 km) from, and parallels, the shore between Long Beach and Pascagoula. At Pass Christian, it swings offshore in a southwesterly direction (Fig. 2). Salinities range down to 6 ppt inside the isobar. Salinities are highest in September-October, when a 20- to 24-ppt isobar lies in about the same position that the 16-ppt isobar did earlier (Christmas and Eleuterius, 1973).

During wet years, however, when high regional rainfall coupled with drainage from the Pearl River basin coincides with flood conditions on the Mississippi River, salinities fall far below this norm (Butler, 1952). Excessive freshwater runoff can reduce salinity normally above 20 ppt in Mississippi Sound to less than 5 ppt (Butler, 1949).

Mississippi Sound has an annual mean water temperature of 72-74°F (22-23°C) with monthly averages ranging between 50°F (10°C) and 90°F (32°C) (Christmas et al., 1966).

Predators, Commensals, and Diseases

The oyster is the symbiotic center of a group of predators, commensals, and molluscan diseases on those Mississippi reefs where high salinities occur.

The most devastating predator is the conch, *Thais haemastoma*. It invades oyster reefs as pelagic larvae when salinities permit, and when its numbers are high it can destroy dense oyster stocks in a few months (Gunter and Demoran, 1971). The following description of the conch is summarized from Butler (1954a).

High densities of conches inhabit areas along the entire Gulf coast. They are generally limited to salinities greater than 15 ppt, but can tolerate lower salinities for brief periods. Reproduction occurs in summer. Growth of juveniles is rapid; they attain 1.0 inch (2.5 cm) in a month; 1.5 inches (3.8 cm) in 2 months; and 2.0 inches (5.1 cm) in 5 months with ample food. They can live several years. When conches are consuming oysters, 10 percent are killed by complete holes through their shells, and 90 percent by incomplete marginal holes; 75 percent of the latter give no evidence of attack. This latter aspect is significant because it is sometimes difficult to establish that conches actually killed oysters. McGraw and Gunter (1972) presented evidence indicating that conches utilize a paralytic secretion produced by the hyprobranchial gland in attacking oysters. Conches also consume mussels, barnacles, clams, and hydroids.

Conches have inhabited some reefs in large numbers in recent years, but they were absent in 1975. It is worthwhile to mention that empty conch shells, the remnants of those killed by low salinities, were also absent. They disappear because hermit crabs occupy and walk away with them.

Crabs and fish are also significant oyster predators (Gunter, 1953; Butler, 1954b; and Menzel and Hopkins, 1956). Blue crabs, *Callinectes sapidus*, (Hopkins, 1955; Menzel and Hopkins, 1956; Mensel and Nichy, 1958; Finucane and Campbell, 1968) and mud crabs (family Xanthidae) (Menzel and Hopkins, 1956; Menzel and Nichy, 1958; and Nichy and Menzel, 1960) are both spat predators. In this study, mud crab predation on spat 0.1-0.4 inches (2.5-10 mm) long was observed. Menzel and Hopkins (1956) also listed the black drum, *Pogonias cromis*, sheepshead, *Archosargus probatocephalus*, and skates, *Raja* sp., as oyster predators in the Gulf of Mexico.

In this study, the presence of an upright branching bryozoan near recently dead spat, 0.1-0.2 inches (2.5-5 mm) long, was observed. MacKenzie (1970a) reported a similar bryozoan which caused mortality in Connecticut and speculated that the animal releases a toxin which kills some nearby organisms.

The most common "commensals" are mussels *(Ischadium recurvum)* and barnacles *(Balanus* sp.). Table 1 lists the 1975 survey estimates of mussel and barnacle abundance on reefs. These, along with mud crabs, are the three animal types most commonly associated with oysters in Mississippi, along the U.S. Atlantic coast, and in the Gulf of St. Lawrence. Butler (1954b) listed the following common commensals of oyster reefs: algae; sponges, both boring and encrusting; hydroids; anemones; polychaete worms; other mollusks, such as jingle shells *(Anomia* sp.), slipper shells *(Crepidula* sp.), and

Table 1.—Densities and sizes of oysters and mussels, and barnacle number/oyster on various reefs in Mississippi Sound, in July 1975. Four to ten areas, each 3 square feet (0.3 square meters) in size, were sampled at each location.

Location	Oysters/ sq yd	Oyster size Range (inches)	Mussels sq yd	Mussel size range (inches)	Barnacles/ oyster
Pass Christian Tonging Reef	103 spat[1] 7 oysters[2]	0.1-1.0	15	—	25
Dredging Reef	130 spat[1] 7 oysters[2]	—	—	—	—
Biloxi Bay	7.5	0.2-4.6 (2.7 avg.)	369	0.1-1.1 (0.5 avg.)	32
Pascagoula River mouth	77	2.1-5.1 (3.0 avg.)	111	0.6-1.0 (0.8 avg.)	8

[1]Spat = 1975 year class.
[2]Oysters = 1973-74 year classes.

oysters of the genus *Ostrea;* bryozoa, both encrusting and upright; and tunicates. Their abundance is sparse in low salinities, but increases to species climax in high salinities. He believed the most significant effect of commensals on oyster productivity is to cover oysters and shells, thereby reducing oyster setting intensity. Another commensal is the boring clam *(Diplothyra smithii)* (Galtsoff, 1964).

The oyster disease *Labyrinthomyxa marina* and unidentified diseases infect and kill oysters especially when high salinities are coupled with high temperatures (Gunter et al., 1974; Gunter and Demoran, 1970, 1971).

In sum, the Mississippi oyster has an extremely high productive potential. Probably the entire bottom of Mississippi Sound would be stocked with a dense oyster population of mixed sizes if all environmental features were favorable for larval settlement and subsequent growth and survival. Oyster reef productivity is largely determined by prevailing salinities which influence survival of oysters, and distribution of predators, commensals, and molluscan diseases. On inshore Pass Christian reefs and in river mouths, bayous, and bays, oyster populations normally thrive and dominate the living community because spat setting is intense, oyster survival is high, and growth is rapid. However, on offshore Pass Christian reefs, spat setting is probably less intense due to greater abundance of commensals, and afterwards conches, crabs, and other predators, as well as microbial diseases kill the oysters. Much of the remaining area of the Sound is unsuitable for oysters because salinities are too high, and the mud and sand bottom is not a substrate on which oyster larvae can easily attach and grow.

USUAL OYSTER STOCKS ON REEFS

Before 1970, the Pass Christian Tonging Reef was so heavily stocked with oysters as a result of regular annual natural setting and growth that there was a surplus after each harvesting season had ended. Each season, the Pass Christian (Henderson Point) Dredging Reef produced a large quantity of steam-stock oysters. In recent years, however, its stocks had declined because vessels retained all oysters including spat on grit that was dredged aboard. They did so because the handling technique changed, resulting in overfishing and retention of small oysters. The crews shovelled oysters when storing them on the vessels' decks rather than piling them by hand and discarding the spat overboard. The offshore Dredging Reefs, i.e., Pass Marianne Reef, Telegraph Key, and Merrill Coquille Reef, produced quantities of oysters about every 10 years. They were productive in 1973, 1974, and 1975 due to floods and low salinities.

THE OYSTER INDUSTRY

The Mississippi oyster industry has significant sentimental and economic value to the people of southern Mississippi. It has provided a livelihood for many families, and oysters are a popular item in restaurants and retail stores in Mississippi and adjoining states.

Oystermen are among the most satisfied of workers because of a high level of personal control over their work and close ties with their product. They feel satisfied with and enjoy oystering when earnings are adequate, even though it does involve moderate physical labor. Enjoyment stems from the autonomy and freedom they have, the sense of peacefulness on the water, the satisfaction from watching animals grow, the working in harmony with nature in a healthy out-of-doors environment, and the harvesting of food for human consumption. Oystermen also have a strong personal attachment to the reefs like farmers to their land, because they provide their livelihood. Individuals experience both lean and boom periods in the years they harvest oysters.

The oyster industry normally operates with high degree of efficiency; maximum use is made of available equipment and resources, and little labor, time, and money are wasted. There is keen daily competition between oystermen within both the tonging and dredging fleets for greatest harvests and earnings; this forces the oystermen to be efficient. When one devises a new technique which increases his productivity, the others quickly copy it to increase their own. At times, oystermen take too many oysters from a reef, which results in its subsequent decline in productivity. Thus, governmental conservation regulations have to be enforced to prevent overfishing and preserve reef productivity. Oystermen want to conserve oyster resources because their livelihood is at stake, but some feel they are not consulted adequately about the best ways to apply the regulations. A status level among oystermen, based on harvests and earnings, prevails in the two oyster fleets, and it is recognized in their communities. Oystermen thrive on the fresh challenge which each new day brings of harvesting sufficient oysters both for a day's pay and for maintaining their status level.

Functional Operations

In Mississippi Sound, oysters are harvested by either tonging from skiffs (Fig. 4) or dredging from larger vessels (Fig. 5). The latter method takes the most volume. Oysters are sold to Biloxi processors (factories and shops) which either steam them open for canning, or shuck them raw and sell them chilled (Fig. 6). In the early part of this century, Biloxi was second only to Baltimore, Md., as the largest oyster processing city in the United States (Churchill, 1920).

Normally, a fleet of about 120-130 skiffs from Mississippi, Alabama, and Louisiana harvests oysters from the Pass Christian Tonging Reef. Fishermen from the latter two states move to Pass Christian for the oyster season. Besides these regulars, some part-timers work the reef during afternoons and weekends to supplement their incomes. The tongers use a 16- to 18-foot (4.9- to 5.5-m) skiff powered by an outboard motor carrying one or two persons; the second person cleans the oysters. Tongers harvest for 6-8 hours each day and usually return to shore by early afternoon.

The daily oyster harvest rate varies with the capacity of the tonger, whether

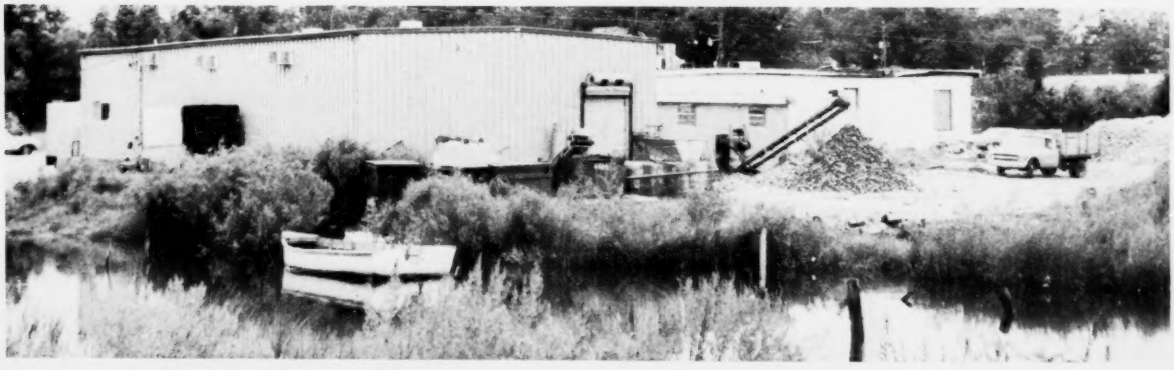
Figure 4.—Tonging oysters from reefs off Pass Christian in the 1960's.

he has a cleaner, and is harvesting for steaming or shucking. When harvesting steam-stock oysters, a skilled tonger can harvest daily 10 barrels alone, or 12 to 15 barrels if he has a cleaner. Steam-stock oysters are sold to either a freight boat anchored on the reef or a trucker ashore. When harvested for shucking, the oysters must be at least 3 inches (7.6 cm) long, and thus the harvest rate is lower. For example, a good tonger working alone can harvest daily 5 barrels, or 7 barrels with a cleaner. Some tongers shuck their own oyster to earn extra money during the off days. It takes from 45 to 60 minutes to shuck a barrel of oysters. Because of weather, a tonger can harvest oysters off Pass Christian only 3 or 4 days a week.

Dredging vessels, motor powered,

Figure 5.—These shrimp boats are converted for oystering only 1 or 2 days after the shrimp season ends.

Figure 6.—Oyster processing shop in Biloxi, Mississippi.



about 50 feet long, average (often termed "Biloxi Luggers"), are used to harvest oysters during the colder months and shrimp during the warmer months. Each has a captain and a crew of usually two, but sometimes more men, and tows one dredge which by State law cannot weigh more than 115 pounds (52 kg) or have more than 16 teeth. In the 1960's there were about 110 vessels on Pass Christian dredging reefs at the beginning of each season.

A dredging vessel can harvest two loads of oysters from Pass Christian dredging reefs and transport them to Biloxi for sale each week. Oysters for steaming are stored loosely on deck, while those for shucking are stored in sacks[3]. It takes a vessel 1 day to harvest a load of 200-300 barrels of steam-stock oysters or 75-100 sacks of raw-stock oysters from a Pass Christian reef and two additional days to run to Biloxi for off-loading and return. It can take longer in bad weather. Vessel captains make contracts or agreements with processors for selling their oysters before harvesting. Those without a contract sometimes have difficulty selling oysters, and have to hold them for a day or so before a sale can be made.

The dredging vessels harvest oysters in either Mississippi or Louisiana, depending upon where harvests and earnings are greater. During the past few years, nearly all dredging vessels have worked in Louisiana, an average 17 hours of running time from Biloxi. However, the 1975-76 season was an exception because the 1973 oyster generation on offshore Pass Christian reefs survived to market size and was available for harvest.

Oysters for canning go into a steaming machine in which they are cooked. The oysters open automatically. They are then placed in a brine solution where the meats float to the surface and are skimmed off, washed, and placed in cans. Shuckers open raw-stock oysters into a tub; later, the oysters are washed with fresh water as they pass over a series of screens. The shells are stored outside the processing plants.

[3]A Mississippi sack = ⅓ of a barrel.

Some Economic Factors

A tonger's skiff, equipped with life jacket, horn, and outboard motor costs him $1,200 to $1,500 and it lasts 4 or 5 years. The skiff has two pairs of tongs which last 2 years; a tong head with 16 teeth costs $38 or $40 with stales. A skiff uses 1 to 2 gallons of gasoline daily. The daily cost of this equipment and gasoline averages nearly $5. Costs of operating dredging vessels were not determined.

Steam-stock oysters bring a much lower price per unit than raw-stock oysters. Oystermen are paid on the basis of the number of cans of meat a harvest of oyster yields. Each barrel yields from 20 to 40 cans (4.5 ounce, drained) of oyster meat. The yield varies by month; lowest values are in fall, highest in winter (Gunter, 1942; Lee and Pepper, 1956). In 1974-75 the steam processors paid oystermen $0.20 per can for whole oysters and $0.10 per can for pieces; usually, 95 percent are whole, 5 percent are pieces. Thus, a daily harvest of 13.5 barrels by a tonger and cleaner was worth about $80; 10 barrels by a tonger alone, about $60; and 250 barrels by a dredging vessel, nearly $1,500. Processors sell canned oysters to large retail outlets. The wholesale value of 4.5-ounce cans was not determined, but 12-ounce cans sell for $0.90-$1.22 each.

Oystermen sell raw-stock oysters mostly by the sack and the remainder shucked. In 1974-75, processors paid from $5 to $6 per sack for Louisiana oysters, a sum about one-third greater than they would have to pay for Mississippi oysters because of extra handling and transportation. Tongers who shuck their own oysters sold these for about $10 per gallon (3.8 liters). The processor then sold these for $13.50 to $14.00 per gallon, a profit of $2.50 to $3.00 per gallon, since overhead and handling cost about $1.00 per gallon. He paid shuckers $3.00, plus $0.25 for social security, per gallon.

Status of Oystermen in 1975

Virtually all tongers had to find other jobs, most at some distance from their homes, since there were few oysters to be tonged in Mississippi Sound. They had faced difficult adjustments because they became hired workers under constant supervision, and may also have lost a high status level in the oyster fleet. In addition, they usually lost earnings in shifting to jobs further from home, such as a longshoreman, tugboat hand, or carpenter's helper. Some went on public welfare and in doing so, lost additional status and self-respect.

The dredgers were inconvenienced and lost earnings because they had to travel to Louisiana to harvest oysters. They sold their harvest to Biloxi, Miss., processors, which meant they were at home only about two nights and could harvest only one 150-sack load of oysters per week. When oysters are available in Mississippi, dredgers usually are at home four to five nights and can harvest two loads of 150 sacks per week. Besides loss of income, the dredgers had to purchase extra fuel to travel to Louisiana.

The oyster processors were affected because they had to purchase most of their oyster supply from Louisiana. These oysters cost $3.00 per barrel more than Mississippi oysters, and processors prefer to purchase from local fishermen and reefs for sentimental reasons.

PHYSICAL CONDITION OF REEFS AND DENSITY OF OYSTERS IN 1975

The Pass Christian reefs are composed of oyster shells. Much of the surface and underlying layers of inshore reefs consist of shells which range up to about an inch in size and are termed grit (Fig. 7). I believe that most are remnants of spat killed by blue crabs and other predators. The offshore reefs consist of grit mixed with larger shells, most of which are remnants of oysters presumably killed by conches and diseases. In 1975 no live conches were seen on any of the reefs inspected.

Pass Christian Tonging Reef (600 acres; 243 hectares)

Most of the reef is covered by only 3 feet (0.9 m) of water (mean low water), but the depth is about 9 feet (2.7 m) at its southern end. In 1975 the surface

consisted of grit which covered about 94 percent of its area and some entire oyster shells, 2-4 inches (5-10 cm) long, many as boxes (shells of recently dead oysters in which the hinge remained unbroken), and a few oysters which covered the remaining 6 percent (Table 1). The boxes were remnants of oysters recently killed by low salinity and fresh water. The effects of wave action reached bottom and maintained it clean of mud and also continuously tossed the top layers of grit to a point to point distance of 6-12 inches (15-30 cm), but large shells and oysters remained stationary. Some oyster spat grew on the large shells and oysters, but none grew on the grit; any spat which had set on grit would likely be killed during windy periods, when the grit was in constant motion.

Figure 7.—Oyster reefs largely consist of small oyster shells termed grit. Sizes of shells can be compared to inch and centimeter marks on ruler.

Pass Christian (Henderson Point) Dredging Reef (1,800 acres; 729 hectares)

The reef area is under 7-12 feet (2.1-3.7 m) of water (mean low water) and is composed of separate reefs, from 5 to 50 acres (from 2 to 20 hectares) in size, which total about 1,000 acres (405 hectares). Each reef has the form of a slight crown, with its center about 12 inches (30 cm) above the edges, and is surrounded by mud. The reef's surface consists of a mixture of grit and large shells. The effect of wave action does not reach bottom to disturb the mud and grit. In 1975, all reefs were covered by a viscous mud deposit as deep as 6-8 inches (14-20 cm) at their edges, thinning to about 2 inches (5 cm) in most areas, and usually absent at the central crown. The mud, spread over reefs by Hurricane Camille, prevented oyster larvae from setting and growing on the grit and shells. The bare reef crowns, from 1 to 2 acres (0.4 to 0.8 hectares) in size, contained spat attached to grit, large shells, and oysters (Table 1).

Pass Marianne, Telegraph Key and Merrill Coquille Reefs (500 acres; 202 hectares)

The reefs lie under only 2-5 feet (0.6-1.5 m) of water (mean low water). Their surfaces contain no mud deposit and are composed mostly of grit which is tossed continually by the effects of wave action. There are also quantities of large oyster shells on and under the reefs' surfaces. In 1975, the reefs were also partially stocked with adult oysters and spat which survived because of the prevailing salinities (less than 15 ppt).

Square Handkerchief Reef (1,000 acres; 405 hectares)

This formerly productive reef was not examined.

Biloxi Bay Reef (300 acres; 121 hectares)

This reef lies on a shell deposit only about five shells deep which, in turn, lie on mud and fine sand. The shells are mostly from 3 to 6 inches (7.6 to 15 cm) long. In 1975, there was an average of 7.5 oysters per square yard (8.9 per square meter). The oysters ranged from spat to large adults and were growing in small clusters (Table 1). The oyster volume ranged between 50 and 400 barrels per acre (124 and 1,000 barrels per hectare) and totalled about 75,000 barrels.

Pascagoula River Mouth Reefs (500 acres; 202 hectares)

These reefs lie on a tightly packed shell deposit a few feet thick. In 1975, they had an average of 77 oysters per square yard (92 per square meter). The oysters ranged from spat to large adults (Table 1). Most were growing in clusters measuring several feet across. The oyster volume was estimated at 250 barrels per acre (618 barrels per hectare), and totalled about 100,000 barrels.

DEVELOPMENT OF REHABILITATION PROGRAM

The rehabilitation program was developed by identifying needs of the oyster industry, examining possibilities of relieving constraints that limit oyster reef productivity, and introducing new methods to relieve these constraints.

Identifying Needs Within Industry

To be successful, the results of a management program for the reefs must satisfy needs of both oystermen and processors. All three sectors, the tongers, dredgers, and processors, were suffering from the oyster shortage. The tongers desired to regain a valued occupation which they lost when the reefs became polluted and barren; dredgers and the processors desired rehabilitation of the Pass Christian reefs so the industry could return to the condition of the 1960's, when the reefs were well

Figure 8.—Oyster vessel, the *Conservationist,* rigged with two booms and dredges (only one is shown) with bottom doors for emptying the oysters.

stocked and earnings were adequate. This need dominated any others.

Relieving Constraints of Oyster Productivity

Every oyster reef is out of balance in that some environmental features are deficient and prevent it from supporting the oyster population which other features would be capable of supporting. Rehabilitation consists of learning the requirements of oyster populations, identifying deficient features, and strengthening them, one at a time. The basic questions are these: 1) are there enough acceptable setting surfaces on a reef for oyster larvae; 2) are features on a reef suitable for growth and survival of spat and larger oysters; and 3) is it feasible to make improvements to relieve constraints? Often a small effort, skillfully applied, produces astonishingly large results. Hopefully, only one or two physical modifications on the Pass Christian reefs would result in huge oyster population increases and fill the reefs to near capacity. This is anticipated because the productive potential of oysters is exceedingly high, and each reef had only one or two major deficiencies. Accordingly, it seemed that recovery of the reefs' oyster populations could be achieved with a simple program and with relatively small effort and expense.

In 1975, the Pass Christian tonging reef had an insufficient quantity of oysters and large shells to collect a set of spat needed to rehabilitate the oyster population; only about 6 percent of the reef's surface was covered. The reef could be immediately rehabilitated by covering it with a concentration of 200 barrels of oysters per acre (500 barrels/hectare), an ideal concentration for tonging. Once rehabilitated, the reef would be self-sustaining with spatfall. An oyster supply for transplanting is available in Biloxi Bay and the Pascagoula River mouth, which contain sufficient oysters to more than cover the reef. Although oysters in these two areas are polluted, they would cleanse themselves on the reef after a short period.

All separate reefs of the Pass Christian (Henderson Point) Dredging Reef were covered by a thin mud deposit, which prevented shells from collecting a set of spat. The reef could be easily rehabilitated by removal of the mud. Similar to the tonging reef, the dredging reef would be self-sustaining with spatfall after it has been rehabilitated.

The Pass Marianne, Telegraph Key, and Merrill Coquille dredging reefs had an insufficient quantity of oysters and shells to collect spat for completely stocking them; they contained only about one-quarter of the oyster supply they could hold. Productivity of the reef could be enhanced by the addition of more large shells.

Introduction of New Aquacultural Methods

Rehabilitation involves use of equipment which should be designed to relieve constraints on specific reefs. No two reefs are identical, and thus, each presents a different set of features which must be dealt with on its own merits. By substituting more efficient equipment for traditional gear used locally, increased productivity can usually be achieved. Often, suitable equipment has been used in another geographic area within the oyster industry and can be modified for local reef conditions.

Methods Tested in 1975

In October 1975, two types of recommended equipment were tested on reefs, and vessel operators were trained in their use.

Boom Oyster Loading System

The Mississippi Marine Conservation Commission constructed a 65-foot (23-m) steel vessel, the *Conservationist,* for transplanting oysters from polluted to clean reefs. I recommended that it be rigged for loading with two booms and dredges, that each have three-barrel capacity, and a door at their bottom to empty the oysters after it is lifted above the deck (Fig. 8). The boom oyster loading system was invented in Connecticut as a labor-saving device during World War II. A boom system of this capacity and design can load a vessel about three times as fast as a conventional roller dredge loading system that is ordinarily used on Mississippi and other Gulf Coast oyster vessels because the dredges are larger and can be handled faster. Under ideal conditions, a vessel so equipped should be able to load to capacity (400 barrels) travel 25 miles (40 km) to Pass Christian reefs, spread the transplanted stock with a water jet, and return in one 12-hour day. Thus, virtually 2 acres (0.8 hectares) of bottom would be covered daily and 400 acres (162 hectares) annually, assuming the vessel would

transplant oysters about 200 days per year. This system is also less expensive than the present roller dredge because only two, rather than four, crew members besides a captain are required. In addition, each deckhand has less work because the dredges are easier to dump and no shovelling of oysters is required.

By using daily vessel costs and crew salaries, the estimated cost would be $0.50 per barrel to transplant oysters from Biloxi Bay to Pass Christian Tonging Reef. This is the cost that Engle (1948) calculated for transplanting oysters with the roller dredge loading system in the 1940's, when costs were much lower.

In October 1975, the new system had been constructed and it was tested and adjusted to perform well in Biloxi Bay. Modifications of the Connecticut prototype because of a softer bottom, included removal of the pressure plate, a shortened bag, larger rings, and larger meshed top net. These modifications aided in flushing mud out of the dredge. The dredge's tooth angle also was reduced to prevent it from digging. On a smaller reef in Biloxi Bay, the knotted net was made of smaller mesh to retain the oysters that were taken as singles, rather than in the clusters usual in this bay.

Transplanting oysters during summer is often impractical because of high mortalities from heat if oysters are held out of water overnight and spread in a different salinity. In July, I gathered 90 oysters from Biloxi Bay, trucked them to Pass Christian, and spread them around a buoy 4 hours after gathering. After 3 weeks only three oysters were dead. This test suggests that oyster transplanting during summer is safe, if oysters can be returned to water on the harvest day.

Mud Cleaning Machine

The Pass Christian (Henderson Point) Dredging Reef could be rehabilitated by towing a mud cleaning machine over it. Machines for this purpose have helped to increase oyster production in Long Island Sound (MacKenzie, 1970b) and Prince Edward Island (MacKenzie, 1975). They remove mud from the bottom quickly and inexpensively. In doing so, they also lift trapped nutrients into the water. Cleaning should be done before and at the beginning of the oysters' setting season, or March through May. I adapted them to operate on this reef. The new machine was 12 feet (8.7 m) wide and consisted of a bar with a row of 5-inch (13-cm) teeth spaced 3 inches (7.6 cm) apart and angled at 45° when towed, for loosening the mud and shells, and a pressure plate 1.5 feet (0.5 m) high, also angled at 45°, and positioned about 5 inches (12.7 cm) above the bar for scouring and lifting the mud (Fig. 9). Once lifted, most mud is carried off the reef by currents; some resettles and has to be relifted by a second cleaning. Ideally, the reef's surface would contain about 2 inches (5 cm) of clean, loose shells and grit after the cleaning is completed.

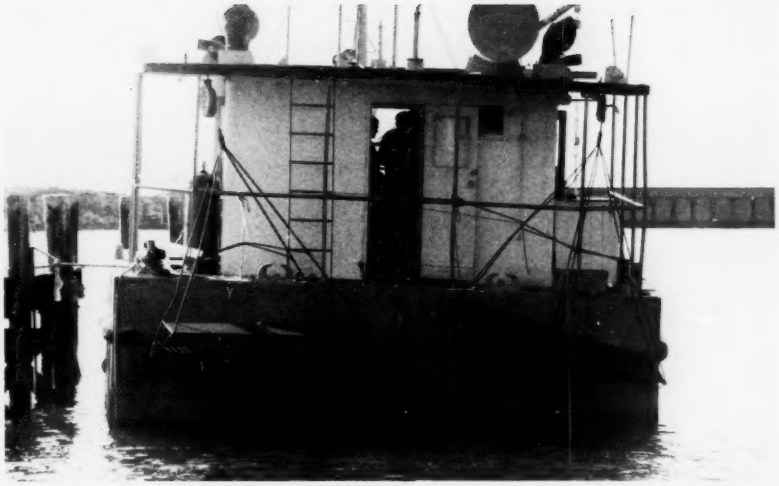


Figure 9.—Two machines for cleaning mud off oyster reefs attached to stern of motorized barge while at dock.

The Commission constructed two mud cleaning machines which were tested by towing them with an 80-foot (25-m) motorized barge over the dredging reef in late October 1975. A 4-acre (1.6-hectare) section of the reef covered by 2 inches (5 cm) of mud was buoyed. The barge then towed the machines at a speed of 3 knots. (1.5 m/sec) for 1.5 hours. A visual inspection of the reef using scuba gear revealed that between 0.5 and 1.0 inches (1.3 to 2.5 cm) of mud was removed and the shells were much looser in paths which the machines had covered once; the surface remained with a loose, thinner mud layer over the shells. Efficiency could be markedly improved by towing either two or three sets of toothed bars and plates, rather than one; with the second and third sets about 4 feet (1.2 m) behind the one in front. The number of sets would depend on the capacity of the towing vessel. The Commission's barge is large enough to pull two machines each having at least three sets of plates and bars.

I estimate that two cleaning machines, each with two or three sets of bars and plates could clean the mud off 10 acres (4 hectares) of reef bottom per 8-hour day, and as much as 400 acres (200 hectares) during March, April, and May. The machines are inexpensive to build and the daily cost of barge operation is about $150; thus the cost of rehabilitating each acre might be only $15 to $20 ($37 to $50/hectare). The lesser important deficiency of the dredging reef, spat predation by crabs, would be partially controlled as the growing oysters provided cover for the successive spat generations.

Method Recommended: Rigid-tine Cultivator

The Pass Marianne, Telegraph Key, and Merrill Coquille reefs had an insufficient density of large oyster shells

as cultch for oyster larvae. Large shells under their surfaces could be raised to the surface by towing a weighted, rigid-tine agricultural cultivator over the bottom. The tines would penetrate 12 inches (30 cm) and be angled slightly forward to raise the shells. This would be an inexpensive method for increasing productivity of the reef when salinities were sufficiently low to permit oyster survival. Blue crab predation would also be partially reduced by the presence of more large oysters on the reefs. A cultivator was not tested on these reefs during this investigation.

RECOMMENDATIONS TO RESTORE MISSISSIPPI OYSTER PRODUCTION AND INDUSTRY

A series of recommendations to make maximum use of Mississippi Sound oyster reefs follows.

1) Programs which attempt to maintain water salinities at proper levels for oysters within Mississippi Sound, especially during droughts, should be supported. If proper salinities can be maintained for longer periods, oyster populations on various reefs have a greater chance of flourishing once they have been reestablished.

2) Programs by municipalities and the State to reduce pollution levels along the Mississippi coast should be enforced. Pollution abatement would be followed by reopening of productive oyster reefs in Biloxi Bay, the Pascagoula River mouth, and others. This would result in a return to oystering as a means of livelihood for many men, higher industrial earnings, greater oyster production, and elimination of a health hazard to the oyster-consuming public.

3) The Pass Christian Tonging Reef should be rehabilitated by transplanting oysters from the Biloxi Bay and Pascagoula mouth reefs by vessels equipped with a boom oyster loading system.

4) The Pass Christian (Henderson Point) Dredging Reef should be rehabilitated by cleaning off the mud deposit with cleaning machines and transplanting oysters from the Biloxi Bay and Pascagoula River mouth reefs. Once restored, a modest quantity of shells should be spread on it periodically to maintain oyster stocks.

5) The Pass Marianne Key, Telegraph Key, and Merrill Coquille oyster reefs could be made significantly more productive during periods of low salinity by returning buried large shells to the surface with a rigid-tine cultivator.

6) The Square Handkerchief Reef should be examined with scuba gear to determine its potential for producing oysters again, a diagnosis of deficient aspects made, and inexpensive equipment developed to rehabilitate it.

7) The oyster reefs in Pt. Aux Chenes Bay and Grand Bay should be rehabilitated by transplanting oysters from the Pascagoula River mouth reefs.

The Mississippi oyster reefs and industry should return to the status they had during the 1960's if this program is fulfilled. During that period, annual production averaged 160,000 barrels, with a value of about 1.5 million dollars, and more than 500 people were employed (Demoran, 1972). This is a minimum figure and higher production is well within the range of possibility.

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LITERATURE CITED

Butler, P. A. 1949. An investigation of oyster producing areas in Louisiana and Mississippi damaged by flood waters in 1945. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 8, 29 p.

_____. 1952. Effect of floodwaters on oysters in Mississippi Sound in 1950. U.S. Fish Wildl. Serv., Res. Rep. 31, 20 p.

_____. 1954a. The southern oyster drill. Proc. Natl. Shellfish. Assoc. 1953 Conv. Pap., p. 67-75.

_____. 1954b. Summary of our knowledge of the oyster in the Gulf of Mexico. *In* P. S. Galtsoff (editor), Gulf of Mexico. Its origin, waters, and marine life, p. 479-489. U.S. Fish Wildl. Serv., Fish. Bull. 55.

_____, and J. B. Engle. 1950. The 1950 opening of the Bonnet Carre Spillway: Its effect on oysters. U. S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 14, 10 p.

Chapman, C. R. 1958. Oyster drill *(Thais haemastoma)* predation in Mississippi Sound. Proc. Natl. Shellfish. Assoc. 49:87-97.

Christmas, J. Y. 1973. Phase I: Area description. *In* J. Y. Christmas (editor), Cooperative Gulf of Mexico Estuarine Inventory and Study, Mississippi, p. 1-71. Gulf Coast Res. Lab., State of Mississippi.

_____, and C. K. Eleuterius. 1973. Phase II: Hydrology. *In* J. Y. Christmas (editor), Cooperative Gulf of Mexico Estaurine Inventory and Study, Mississippi, p. 73-121. Gulf Coast Res. Lab., State of Mississippi.

_____, G. Gunter, and P. Musgrave. 1966. Studies of annual abundance of postlarval penaeid shrimp in the estuarine waters of Mississippi, as related to subsequent commercial catches. Gulf Res. Rep. 2(2): 177-212.

_____, and W. Langley. 1973. Sect. 4. Estuarine invertebrates, Mississippi. *In* J. Y. Christmas (editor), Cooperative Gulf of Mexico Estuarine Inventory and Study, Mississippi. Phase IV: Biology, p. 255-319. Gulf Coast Res. Lab., State of Mississippi.

Churchill, E. P., Jr. 1920. The oyster and the oyster industry of the Atlantic and Gulf coasts. (U.S.) Bureau of Fisheries, Report of The Commissioner of Fisheries for the fiscal year 1919. Appendix VIII (Document 890), 51 p.

Cross, R. D., R. W. Wales, and C. T. Traylor. 1974. Atlas of Mississippi. Univ. Press Miss., Jackson, 187 p.

Demoran, W. J. 1966. Homes for oysters. Miss. Game Fish. 26(3):12-13.

_____. 1972. Oyster production in the State of Mississippi for 1927 to 1972 and the State's management of the Mississippi oyster fishery. Proceedings of a public symposium on the oyster fisheries of the Gulf States, p. 16-22. Biloxi, Miss.

Engle, J. B. 1948. Investigations of the oyster reefs of Mississippi, Louisiana, and Alabama following the hurricane of September 19, 1947. U.S. Fish Wildl. Serv., Spec. Sci. Rep. 59, 70 p.

Finucane, J. H., and R. W. Campbell, II. 1968. Ecology of American oysters in Old Tampa, Bay, Florida. Q. J. Fla. Acad. Sci. 31(1):37-46.

Ford, T. 1970. Effects of Hurricane Camille on Louisiana's oyster growing areas east of the Mississippi River — Lake Borgne to California Bay and other marine fisheries industries. 13th Biennial Report 1968-69, p. 78-83. La. Wildl. Fish. Comm.

Galtsoff, P. S. 1964. The American oyster *Crassostrea virginica* Gmelin. U.S. Fish Wildl. Serv., Fish Bull. 64, 480 p.

Gunter, G. 1942. Seasonal condition of Texas oysters. Proc. Trans. Tex. Acad. Sci. 25:89-93.

_____. 1952. Historical changes in the Mississippi River and the adjacent marine environment. Publ. Inst. Mar. Sci. Univ. Tex. 2(2):119-139.

_____. 1953. The relationship of the Bonnet Carré Spillway to oyster beds in Mississippi Sound and the "Louisiana Marsh," with a report on the 1950 opening. Publ. Inst. Mar. Sci. Univ. Tex. 3:17-71.

_____. 1975. Mariculture in Mississippi; oyster management by the State. *In* B. N. Irby and D. McCaughan (editors), Guide to the marine resources of Mississippi, p. 104-114. Fox Printing Co., Hattiesburg, Miss.

_____, B. S. Ballard, and A. Venkataramiah. 1974. A review of salinity problems of organisms in United States coastal areas subject to the effects of engineering works. Gulf Res. Rep. 4(3):380-475.

_____, and W. J. Demoran. 1970. Successful management of the oyster fishery by the State of Mississippi. Proc. Symp. Mollusca. Mar. Biol. Assoc. India. Part III, p. 899-905.

_____, and _____. 1971. Mississippi

oyster culture. Am. Fish Farmer 2(5):8-12.
Hopkins, A. E. 1954. Oyster cultural experiments on the Mississippi Gulf Coast. J. Miss. Acad. Sci. 6:31-32.
Hopkins, S. H. 1955. Oyster setting on the Gulf coast. Proc. Natl. Shellfish. Assoc. 45:52-55.
Ingle, R. M., and C. E. Dawson, Jr. 1952. Growth of the American oyster, *Crassostrea virginica* (Gmelin) in Florida waters. Bull. Mar. Sci. Gulf Caribb. 2(2):393-404.
Lee, C. F., and L. Pepper. 1956. Composition of southern oysters. Commer. Fish. Rev. 18(7):1-6.
Lyles, C. H. 1969. Historical catch statistics (shellfish). U.S. Fish Wildl. Serv., Curr. Fish. Stat. 5007, 116 p.
McGraw, K. A., and G. Gunter. 1972. Observations on killing of the Virginia oyster by the gulf oyster borer, *Thais haemastoma*, with evidence for a paralytic secretion. Proc. Natl. Shellfish. Assoc. 62:95-97.
MacKenzie, C. L., Jr. 1970a. Causes of oyster spat mortality, conditions of oyster setting beds, and recommendations for oyster bed management. Proc. Natl. Shellfish. Assoc. 60:59-67.
———. 1970b. Oyster culture in Long Island Sound 1966-69. Commer. Fish. Rev. 32(1):27-40.
———. 1975. Development of a program to rehabilitate the oyster industry of Prince Edward Island. Mar. Fish. Rev. 37(3):21-35.
Mackin, J. G. 1951. Histopathology of infection of *Crassostrea virginica* (Gmelin) by *Dermocystidium marinum* Mackin, Owen, and Collier. Bull. Mar. Sci. Gulf Caribb. 1(1):72-87.
Maghan, B. W. 1967. The Mississippi oyster industry. U.S. Fish Wildl. Serv., Fish. Leafl. 607, 12 p.
Menzel, R. W., and S. H. Hopkins. 1956. Crabs as predators of oysters in Louisiana. Proc. Natl. Shellfish. Assoc. 46:177-184.
———, and F. E. Nichy. 1958. Studies of the distribution and feeding habits of some oyster predators in Alligator Harbor, Florida. Bull. Mar. Sci. Gulf Caribb. 8(2):125-145.
Nichy, F. E. and R. W. Menzel. 1960. Mortality of intertidal and subtidal oysters in Alligator Harbor, Florida. Proc. Natl. Shellfish. Assoc. 51:33-41.

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MFR PAPER 1260

Ciguatera in the U.S. Virgin Islands

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INTRODUCTION

Ciguatera is a type of fish poisoning that a person or animal can get from eating certain species of tropical fishes. Brody (1972) notes that several types of fish poisoning, including ciguatera, have been reported in the eastern Caribbean since pre-Columbian times.

Ciguatera research in the Pacific has been extensive and comprehensive reviews are given by Halstead (1967) and Banner (1965). Presently, the relationship between ciguatera in the Pacific and in the Caribbean is obscure, and no information is available on the biochemical nature of Caribbean ciguatoxin. Although ciguatera symptoms observed in the Caribbean and Pacific are similar, there is no basis to conclude similarity in origin or chemical nature.

Continued information is being developed and compiled in the Pacific on the pharmacology, chemistry, and origin of ciguatera (Yasumoto et al., 1971; Banner, 1965; Okihiro et al., 1965; Li, 1965a). This paper reviews the ciguatera problem in the U.S. Virgin Islands.

ORIGIN AND NATURE OF CIGUATERA

In the Virgin Islands and the Pacific, it is generally believed that ciguatoxin originates in the environment and then accumulates in the flesh and internal organs of affected fish. Available evidence suggests the toxin is concentrated within the food web, with its primary source as an alga, fungus, protozoan, or bacterium (Randall, 1958).

In size-age distribution, larger older fish of a species are more likely to be poisonous than smaller and younger individuals of the same species. This pattern is repeated in the Pacific (Banner et al., 1964).

The symptoms of ciguatera poisoning in the Virgin Islands are similar to those reported elsewhere (Okihiro et al., 1965; Halstead, 1967). Within 5 to 6 hours after ingestion of ciguatoxic fish, a person generally experiences abdominal pain, nausea, vomiting, and other symptoms of gastroenteritis accompanied by a rapid diuresis. There may be a tingling sensation in the extremities and numbness may occur. In almost all cases, there is a feeling of weakness which may become progressively worse. With severe poisoning there may be paradoxical sensory disturbances whereas cold objects may be described as burning or tingling, and hot objects may be described as cold.

Toxic symptoms in a living animal are the result of a complex array of toxin-receptor interactions that find expression in a limited number of target organs (Li, 1965b). Further, toxins of widely different chemical structures may give rise to similar or identical symptoms (Bagnis et al., 1970). The symptoms described above for suspected ciguatera poisoning, can equally be applied to a variety of food poisons such as staphylococcal intoxication (Kawabata et al., 1955). Therefore, reasonable cause for assuming ciguatera poisoning exists where proper handling, preparation, and serving of fresh fish is observed.

Medical treatment of ciguatera is symptomatic and has been described by Okihiro et al. (1965). In the Virgin Islands, an estimated 10-15 percent of the yearly total cases of ciguatera poisoning are severe enough to require hospitalization or are brought to the attention of medical and health authorities. Commonly, persons are treated at home using a variety of medicinal plants as shown in Table 1 (Peterson, 1974; Little et al., 1974). At present the efficacy of these remedies has not been established by medical science.

CIGUATOXIC SPECIES AND LOCATIONS

In the Virgin Islands, the Caribbean, and in the Pacific, some species of fish are more likely to be ciguatoxic than others (Table 2). As a family, the carangids or jacks contain the most species prone to ciguatera followed by snappers and groupers. Further, ciguatoxic fish in the Virgin Islands are primary or secondary predators that prey almost exclusively on other fish.

The majority of fishing in the Virgin Islands is done with fish traps or pots (Sylvester and Dammann, 1972). In these waters, fish of a size caught in traps usually are not ciguatoxic, although there are notable exceptions

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Table 1.—Medicinal plants used in the Virgin Islands to treat the symptoms of ciguatera fish poisoning. (The efficacy of these remedies has not been established by medical science.)

Common name	Scientific name	Symptoms treated
Anise	*Piminella anisum*	Cramps, abdominal pain
Arrowroot	*Moranta arundinacea*	Diarrhea
Balsam	*Ocimum sanctum*	Nervous disorders, abdominal pain
Bitterash	*Picraena excelsa*	Abdominal pain, fever
Black torch	*Exastemma caribeaum*	Nausea
Button wood	*Conocarpus erecta*	Nausea, vomiting
Kenip	*Melicocca bijuga*	Diarrhea
Lignum vitae	*Guaicum officinalis*	Debility to restore energy
Maubi bark	*Rhamabaceae* sp.	Cramps
Pap vine	*Passifloraceae* sp.	Nervous disorders
Rosemary	*Rosmarinus officinalis*	Nervous disorders
Black sage	*Cordia ulmifolia*	Fevers, nervous disorders
Snakeroot	*Strychnos nux vomica*	Cramps
Stack-ma-hark	*Rivina humilis*	Diarrhea
White bark	*Canelia alba*	Cramps, pain
Worm wood	*Artemisia absinthium*	Cramps

Table 2.—Fish species most likely to be ciguatoxic in the U.S. Virgin Islands (Randall, 1958; Bohlke and Chaplin, 1968).

Family	Common name	Scientific name
Sphyraenidae	Barracuda	*Sphyraena barracuda*
Serranidae	Yellowfin grouper	*Mycteroperca venenosa*
	Yellowmouth grouper	*M. interstitialis*
	Misty grouper	*Epinephelus mystacinus*
Carangidae	Amberjack	*Seriola dumerili*
	Bar jack	*Caranx ruber*
	Crevalle jack	*C. hippos*
	Horse-eye jack	*C. latus*
	Black jack	*C. lugubris*
	Blue runner	*C. crysos*
	Pompano	*Alectis crinitus*
Lutjanidae	Cubera snapper	*Lutjanus cyanopterus*
	Schoolmaster	*L. apodus*
	Dog snapper	*L. jocu*
	Mahogany snapper	*L. mahogoni*
Labridae	Spanish hogfish	*L. bodianus rufus*
	Spotfin hogfish	*B. pulchellus*
	Hogfish	*Lachnolaimus maximus*
Balistidae	Triggerfish	*Balistes vetula*

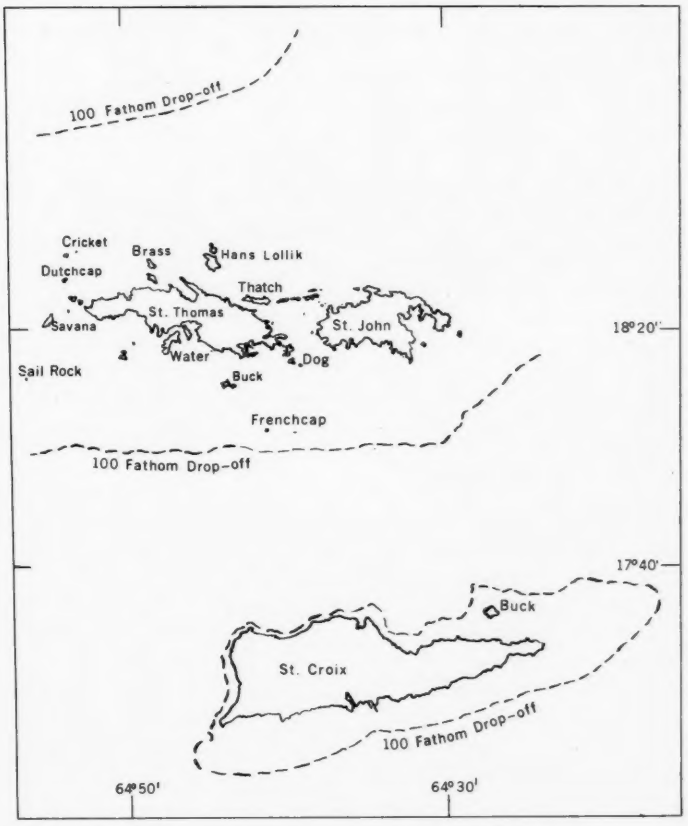

Figure 1.—Map of the U.S. Virgin Islands with major islands and cays. St. Croix is approximately 40 miles south of St. Thomas-St. John.

which include some carangids and groupers.

Some areas in the islands are more likely to produce poisonous fish than other areas. Fishermen in the Virgin Islands believe the areas south of St. Thomas-St. John yield more poisonous fish than areas north of St. Thomas-St. John (Figure 1). Around the island of St. Croix, about 40 miles south of St. Thomas, yields of poisonous fish are highest about the eastern tip of the island.

Some suspected ciguatoxic species are not eaten from certain locations but are consumed from other areas within the Virgin Islands. Large barracuda (*Sphyraena* sp.) are not usually eaten from the St. Thomas-St. John area, but on St. Croix they are marketed and sold for consumption. Species that are commonly ciguatoxic in the Virgin Islands are ciguatera-free in other areas of the Caribbean. For example, amberjack, *Seriola dumerili*, notoriously ciguatoxic in the Virgin Islands, are marketed and eaten in Puerto Rico, 100 miles west of St. Thomas.

The depth at which fish are caught is important in the distribution of ciguatoxic fish. Exploratory fishing for ciguatera-free fish populations has shown a very low incidence of poisonous fish from areas near and on the 100-fathom curve in the Virgin Islands (Dammann, 1969; Brownell, 1971; Sylvester and Dammann, 1974).

CIGUATERA AND FISHERIES MANAGEMENT IN THE VIRGIN ISLANDS

Fisheries management in the tropics poses unique problems because of the nature of the resources. Tropical fisheries are characterized by large numbers of species, with relatively few individuals within each species. Commercially and recreationally, few species are sought for food or sport. Ciguatera is not a problem for the sports fisherman who does not eat or sell his

catch. However, for fish intended for human consumption, the ciguatera problem is of great importance.

Fisheries management in the Virgin Islands has, as one of its main objectives, the task of maximizing catch in terms of pounds and numbers of fish on a sustained basis. Due to the nature of the fishery, i.e., a tropical fishery, maximum yield levels must be determined for many different species; however, yields in pounds and numbers are generally low (Dammann, 1969; Brownell, 1971; Sylvester and Dammann, 1974).

Demand for fresh fish in the Virgin Islands exceeds supply (Dammann and Sylvester, In press) and to meet this demand, the fishery must concern itself with as many different species as possible. In the islands, species prone to ciguatera are not, in effect, available for commercial exploitation. Hence, the ciguatera problem in the Virgin Islands inhibits full utilization of available and acceptable resources because of its sporadic and unpredictable nature.

SUMMARY AND CONCLUSIONS

Ciguatera has a long and continuing history in the U.S. Virgin Islands. Throughout the years, much folklore has accumulated about its origins, mode of transmission in the environment, and treatment of its symptoms.

Little reliable evidence is available on the biological and ecological nature of ciguatera in the islands. Quantitative data is sparce on species, location, and areal and seasonal distributions. Probability statements with adequate confidence limits cannot be made for individual fish caught from any location. A simple, effective, reliable test for individual fish which does not involve human or animal consumption is not available.

In conclusion, ciguatera is a serious hindrance to full commercial exploitation of the limited Virgin Islands fisheries resources, and much work needs to be done here in the islands and throughout the Caribbean.

LITERATURE CITED

Bagnis, R., F. Berglund, and P. S. Elias. 1970. Problems of toxicants in marine food products: 1. Marine biotoxins. Bull. WHO 42:69-88.

Banner, A. H. 1965. Ciguatera in the Pacific. Hawaii Med. J. 24:353-354.

Banner, A. H., P. Helfrich, P. J. Scheuer, and T. Yoshida. 1964. Research on ciguatera in the tropical Pacific. Gulf Caribb. Fish. Inst., Proc. 16th Annu. Sess., p. 84-98.

Böhlke, J. E., and C. C. G. Chaplin. 1968. Fishes of the Bahamas and adjacent tropical waters. Livingston Publ. Co., Wynnewood, Pa., 771 p.

Brody, R. W. 1972. Fish poisoning in the eastern Caribbean. Gulf Caribb. Fish. Inst., Proc. 24th Annu. Sess., p. 100-116.

Brownell, W. N. 1971. Fisheries of the Virgin Islands. Commer. Fish. Rev. 33(11-12):23-30.

Dammann, A. E. 1969. Study of the fisheries potential of the Virgin Islands. Caribb. Res. Inst., Virgin Islands Ecol. Res. Stn., Contrib. No. 1, 197 p.

Dammann, A. E., and J. R. Sylvester. In press. Review of the status of the Virgin Islands fisheries. Caribb. Fish. Manage. Counc. Rep.

Halstead, B. W. 1967. Poisonous and venemous marine animals. Vol. II. U.S. Gov. Print. Off., Wash., D.C., 1,070 p.

Kawabata, T., K. Ishizaka, and T. Miura. 1955. Studies on the allergy-like food poisoning associated with putrefaction of marine products. II. Separation of causative substance and some of its chemical characteristics. Jpn. J. Med. Sci. Biol. 8:503-519.

Li, K. M. 1965a. A note on ciguatera fish poison and action of its proposed antidotes. Hawaii Med. J. 24:358-361.

_____. 1965b. Ciguatera fish poison: a cholinesterase inhibitor. Science (Wash., D.C.) 147:1580-1581.

Little, E. L., Jr., R. O. Woodbury, and F. H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands. U.D. Dep. Agric., Handb. 449, Wash., D.C., 1,024 p.

Okihiro, M. M., J. P. Keenan, and A. C. Ivy. 1965. Ciguatera fish poisoning with cholinesterase inhibition. Hawaii Med. J. 24:354-357.

Peterson, A. 1974. Herbs and proverbs of the Virgin Islands. St. Thomas Graphics. St. Thomas, V.I., 78 p.

Randall, J. E. 1958. A review of ciguatera, tropical fish poisoning, with a tentative explanation of its cause. Bull. Mar. Sci. Gulf Caribb. 8(3):236-267.

Sylvester, J. R., and A. E. Dammann. 1972. Pot fishing in the Virgin Islands. Mar. Fish. Rev. 34(9-10): 33-35.

_____. 1974. Some observations on the deepwater fishery resources of the Virgin Islands. Caribb. J. Sci. 14:163-165.

Yasumoto, T., Y. Hashimoto, R. Bagnis, J. E. Randall, and A. H. Banner. 1971. Toxicity of the surgeonfishes. Bull. Jpn. Soc. Sci. Fish. 37(8):724-734.

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The Economic Performance of Oregon's Commercial Fishermen in 1972

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INTRODUCTION

This paper provides industry and government personnel with detailed information on the economic performance of Oregon's fishermen engaged in commercial fishing during the 1972 season. Specifically, the paper covers: 1) socioeconomic characteristics of fishermen; 2) costs and returns of commercial fishing; 3) production functions of commercial fisheries; and 4) fishermen's income from fishery and nonfishery employment.

These data are important to policy makers. Under the Fishery Conservation and Management Act of 1976, management of fishery resources will require socioeconomic data and analyses because of their inclusion in addition to biological consideration embodied in maximum sustainable yield. Financial institutions also need information about costs and returns. In addition, these data are useful to boat owners and skippers as benchmarks for comparing their costs and returns with those of average fishermen. These data comparing fishing and nonfishing income from part-time and full-time fishermen could be useful to fishermen and potential fishermen in their choice of occupation.

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DATA SOURCE AND DESCRIPTION

The data used in this study were derived from a survey designed to obtain knowledge of the operations and performance of Oregon's commercial fishermen. All Oregon skippers in the major fisheries constituted the "population" of the survey. An Oregon skipper was defined as a boat captain who had a commercial fishing license and resided in Oregon. The seven types of fishermen surveyed were:

renewal salmon — fishermen who trolled for salmon in both 1971 and 1972.

entry salmon — fisherman who trolled for salmon in 1972 but not in 1971.

exit salmon — fishermen who trolled for salmon in 1971 but not in 1972.

crab — fishermen who landed crab in 1972.

salmon and tuna — fishermen who fished for salmon and tuna in 1972.

salmon and/or tuna with crab — fishermen who fished for salmon and/or tuna, and for crab, in 1972.

drag — fishermen who fished for shrimp and/or bottom fish, and for crabs and/or tuna, in 1972.

Data were gathered by personal interview with randomly sampled skippers. The sample size for each type of fisherman is shown in Table 1. Questionnaires were administered after pretesting, and a total of 214 skippers were interviewed in the survey.

All data were for the period covering the 1972 season. It should be noted that economic performance of fishermen depends upon unit prices and total landings. The 1972 season appears to have been a fairly typical year with respect to price paid to fishermen for the major fish species (Table 2). Total landings were below average for crab and salmon, and above average for tuna and shrimp.

CHARACTERISTICS OF COMMERCIAL FISHERMEN

Specialized salmon fishermen (renewal salmon, entry salmon, and exit salmon) have less commercial fishing experience than do other types of fishermen (Table 3). However, they have more nonfishery employment experience than other types of fishermen.

Table 1.—Survey of Oregon's skippers[1].

Type of fishermen	Sample size	Estimated[2] population	Sample size (percent)
Fished in 1972			
Specialized[3]			
Renewal salmon	97	1,170-1,980	5-8
Entry salmon	16	130-220	7-12
Crab	11	35-60	18-31
Combination[4]			
Salmon-tuna	24	120-205	12-20
Salmon-tuna/crab	30	95-155	19-32
Drag (shrimp and/or bottomfish, with crab and/or tuna)	25	50-85	29-50
Subtotal for 1972	203	1,600-2,705	8-13
Fished in 1971 only			
Exit salmon	11	385-575	2-3
Total	214	1,985-3,280	7-11

[1]Excludes gillnetters, specialized tuna, clam diggers, shad, etc.
[2]The total number of skippers in each "type" is not known; thus, a range is given. The smaller numbers were derived from the sampling frame. The larger numbers reflect an upward adjustment of the sampling frame in order to reconcile the number of skippers with the number of commercial boat licenses issued by the Oregon Fish Commission. The latter figures were 3,487 in 1971 and 3,314 in 1972; these include an undetermined number of gillnet fishermen.
[3]Obtained at least 85 percent of the total value of their landings from a single fishery.
[4]Obtained at least 10 percent of the total value of their landings from each of two or more fisheries, with at least 85 percent from these two or more fisheries combined.

Table 2.—Ex-vessel price per pound and total landings of major fisheries in Oregon.

Item	Chinook salmon	Coho salmon	Crab	Shrimp	Tuna	Bottomfish
Ex-vessel price per pound ($)						
1969-73 weighted avg.	0.57	0.46	0.46	0.14	0.29	0.09
1972 season	0.57	0.50	0.42	0.14	0.31	0.09
Percent difference[1]	(0)	(+9)	(−9)	(0)	(+7)	(0)
Total landings (million pounds)						
1969-73 avg.	6.248	8.718	9.740	15.633	24.703	22.284
1972 season	5.085	6.483	6.762	20.731	29.234	22.801
Percent difference[1]	(−19)	(−26)	(−31)	(+33)	(+18)	(+2)

[1]1972 season relative to 1969-73 average.
Source: Data compiled by the Fish Commission of Oregon (now the Oregon Department of Fish and Wildlife).

Table 3.—Characteristics of Oregon skippers and their commercial fishing boats, 1972.

Characteristics	Average for specialized fishermen				Average for combination fishermen		
	Renewal salmon	Entry salmon	Exit salmon[1]	Crab	Salmon-tuna	Salmon-tuna/crab	Drag
Skippers							
Age	44	46	45	55	49	45	47
Formal education (years)	12	11	11	10	12	12	11
Nonfishery employment experience (years)	21	14	15	12	14	10	4
Miles from home town to port	27	28	45	0	15	0	0
Fishing experience (years)	8	2	10	24	16	18	22
Fishing Boats							
Age (years)	14	6	—[2]	22	26	24	29
Length (feet)	26	23	—	37	39	44	54
Beam (feet)	9	8	—	11	11	13	15
Horsepower	104	113	—	164	138	168	237
Total value of boat ($)	7,016	5,420	—	22,000	30,054	30,936	66,761
Number of crab pots	0	0	—	215	0	254	171
Number of men on the boat	1.5	1.5	—	2	2	3	3

[1]Data is from the 1971 fishing season.
[2]Not available.

The boat operated by the average salmon fisherman is between 23 and 26 feet in length, and is valued at between $5,000 and $7,000. In contrast, the average drag fishermen's boat has a market value of about $66,750. The market value of all other fishermen's boats is between $22,000 and $30,000.

Specialized salmon fishermen generally have a one- or two-man crew on their boats. Salmon-tuna fishermen generally employ one crew member; salmon-tuna/crab and drag fishermen usually employ two.

Specialized salmon fishermen spent about 32-40 days fishing and 8-19 days on maintenance and repair of boat and gear (Table 4). Their total days devoted to the fishery ranged from 45 to 55. Crab and salmon-tuna fishermen spend about 4 months in the fishery; tuna/crab and drag fishermen, approximately 7 months.

Approximately 85 percent of all specialized salmon skippers had nonfishery employment. For those who worked outside the fishery, total time spent in nonfishery employment was about 11 months. Thus, salmon fishing is usually done to supplement income from employment outside the fishing industry. Only 50 percent of the salmon-tuna fishermen have nonfishery employment, even though the length of their fishing season is only about 4 months.

Crab, salmon-tuna/crab, and drag fishermen spend the least time working outside the fishery. The 20 percent who do work outside the fishery spend, on the average, only 4-5 months at nonfishery jobs. Thus, in these three fisheries almost everyone is a full-time fisherman. These fishermen tend to live in coastal areas where nonfishery jobs are not always easy to find.

COSTS AND RETURNS IN COMMERCIAL FISHING

The gross returns are amounts received from the sale of fish landed during the survey year, regardless of where they were landed. The average gross returns of the seven types of fishermen varied considerably. Drag fishermen had considerably higher gross returns

per year ($73,808) than other types of fishermen (Table 5). Gross returns per fishing day were about $443 for drag fishermen and from $38 to $61 for salmon fishermen. Crab fishermen received about $312 gross returns per fishing day.

Production costs are categorized as variable or fixed. Variable costs comprise all cost items that are incurred only if the boat is actually used for fishing. Fixed costs include cost items that do not vary with fishing effort (annual depreciation, insurance, license fees, etc.). Depreciation was calculated on a straight-line basis using 18 years of remaining life and a zero salvage value for the boat. The average age of the larger boats is 22-29 years; this means that the expected life of a large boat is 40-47 years.

Variable costs for the average drag fishermen were about $36,000, compared with $1,000 to $1,600 for specialized salmon fishermen. Fixed costs were about $9,000 for drag fishermen and $600 for specialized salmon fishermen. Total production costs for drag fishing were about $45,000, some 20-30 times higher than total costs for specialized salmon fishermen, and twice as high as that for salmon-tuna/crab.

The ratios of gross return to total investment were relatively low for specialized salmon fishermen and salmon-tuna fishermen. The ratio of gross returns to total costs was the highest for salmon-tuna/crab fishermen, indicating high efficiency in their use of operating capital.

With regard to the efficiency of labor, the ratios of gross returns to numbers of men fishing indicated that specialized salmon fishermen produced very low returns to their labor input into the fishery. In addition, specialized salmon fishermen received low gross returns per day fished.

The average specialized salmon fisherman had total costs greater than gross returns, while the average crab and combination fishermen had gross returns greater than total costs. Gross returns less total costs were about −$60 to −$400 for the specialized salmon fishermen, $3,400 for the salmon-tuna fishermen, $8,600 for crab fishermen, $15,800 for salmon-tuna/crab fishermen, and $28,600 for drag fishermen.

This study assumes that opportunity cost of a skipper's investment in fishing

Table 4.—Characteristics of fishery and nonfishery employment by Oregon's commercial fishermen.

Characteristics	Average for specialized fishermen				Average for combination fishermen		
	Renewal salmon	Entry salmon	Exit salmon[1]	Crab	Salmon-tuna	Salmon-tuna/crab	Drag
Fishery employment							
Days spent fishing for							
Salmon	36	32	40	0	52	52	0
Crab	0	0	0	88	0	79	24
Tuna	0	0	0	0	33	27	1
Bottomfish	0	0	0	0	0	0	60
Shrimp	0	0	0	0	0	0	52
Total days fished	36	32	40	88	85	158	137
Days spent on maintenance and repair of boat and gear	19	14	8	34	34	47	50
Nonfishery employment							
Percent of skippers with nonfishery employment	84	94	82	18	50	23	20
Average length of nonfishery employment for all skippers (months)	9	10	10	2	4	1	1
Average length of nonfishery employment for those working outside the fishery (months)	11	11	12	7	8	4	5

[1]Data is from the 1971 fishing season.

Table 5.—Comparisons of costs, returns, and efficiency among Oregon commercial fishermen, 1972.

Financial and efficiency indicators	Average for specialized fishermen				Average for combination fishermen		
	Renewal salmon	Entry salmon	Exit salmon[1]	Crab	Salmon-tuna	Salmon-tuna/crab	Drag
Sample size	67	12	9	8	21	19	16
Investment ($)[2]	6,590	6,167	5,461	22,438	31,848	35,079	80,593
Costs and returns ($)							
Gross returns	2,215	1,229	1,154	25,721	11,369	36,807	73,808
Variable costs[3]	1,651	1,078	1,568	14,531	5,080	17,465	35,978
Fixed costs[4]	622	522	N/A	2,548	2,874	3,504	9,261
Gross returns less total costs	−58	−371	−414	8,642	3,415	15,838	28,569
Return to labor and management[5]	−652	−926	−905	6,623	549	12,681	21,316
Return to investment[6]	−945	−863	−876	−1,645	−1,133	1,115	−954
Efficiency ratios ($)[7]							
Gross return per dollar of total investment	0.40	0.20	0.40	1.20	0.40	1.10	1.00
Gross return per dollar of total cost	1.00	0.70	0.80	1.80	1.40	2.30	1.70
Gross return per man fishing	1,376	716	—	15,279	6,060	12,129	20,254
Gross return per day fished	61	38	45	312	133	234	443
Total cost per day fished	87	270	90	217	114	141	273

[1]1971 fishing season.
[2]Market value of the boat and gear.
[3]Costs that vary with fishing effort (fuel, boat repair, gear repair, crew's share, etc.)
[4]Costs that do not vary with fishing effort (insurance, license fees, association assessments, depreciation, etc.)
[5]Gross returns less total costs less opportunity cost of investment (9 percent of investment).
[6]Gross returns less total costs less opportunity cost of skipper's labor and management (40 percent of gross return).
[7]As an example of how these ratios were calculated, suppose that one fisherman's ratio of "gross return per day fished" was $250 per day. If a second fisherman's ratio was $200 per day, the average of the two would be $225 per day. (The ratios in the table cannot be derived from tables 3, 4, and 5 because of the mathematical nature of the ratio.)

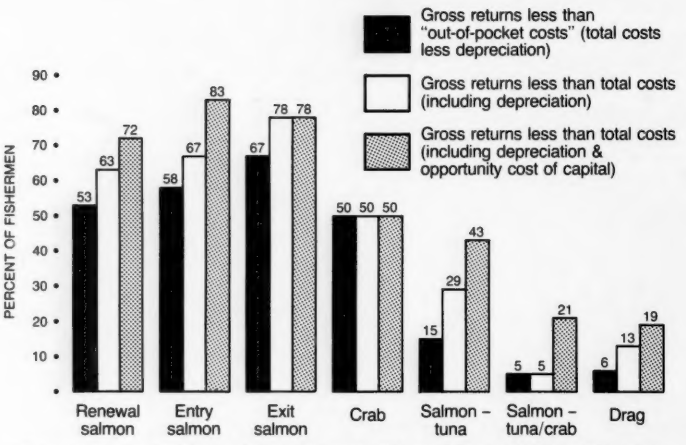

Figure 1.—Percent of fishermen incurring losses in 1972, by different definitions of "profit."

Table 6.—Production functions[1] and related statistics by type of fisherman in Oregon, 1972.

Item	Type of fisherman					
	Renewal salmon	Entry salmon	Crab	Salmon-tuna	Salmon-tuna/crab	Drag
Value of a (log form)	−0.477	−0.699	−7.027	−6.636	−1.426	1.142
Value of b_i:						
Boat capital (b_1)	0.322	0.382	1.164	0.319	0.531	0.491**
Operating capital (b_2)	0.181	0.251	−0.085	0.530*	0.573**	0.290
Fishing days (b_3)	0.885***	0.931***	1.337	0.223	0.237	0.360
Fishing experience (b_4)	0.311*	−0.444	−0.011	0.383*	−0.185	−0.132
t-value:						
Boat capital	1.663	1.528	0.404	1.612	1.377	2.818
Operating capital	0.760	0.579	−0.030	2.109	2.697	1.447
Fishing days	4.864	6.731	0.321	1.145	0.669	0.951
Fishing experience	1.786	−0.123	−0.009	1.815	−0.904	−0.648
R^2	0.52	0.99	0.61	0.88	0.64	0.77
Sample size	67	12	8	21	19	16

[1] $\log y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4$.

***Significant at 1 percent probability level.
**Significant at 5 percent probability level.
*Significant at 10 percent probability level.

gear and vessel is 9 percent of the market value of the investment. This percentage was chosen because AAA-rated bonds are paying over 9 percent interest; if a fisherman sold his boat at its market value and invested the money elsewhere, he could expect at least a 9 percent return on his investment. When this opportunity cost is deducted from gross returns less total costs, the remainder is the return to the skipper's labor and management. The average return to labor and management was from −$652 to −926 for specialized salmon fishermen, $549 for salmon-tuna fishermen, $6,623 for crab fishermen, $12,681 for salmon-tuna/crab fishermen, and $21,316 for drag fishermen.

The percentages of fishermen who sustained losses in fishing are shown in Figure 1. Among the renewal salmon fishermen, for example, 53 percent had gross returns which were less than "out-of-pocket" costs (i.e., total costs less depreciation). This group clearly had unprofitable operations in 1972. When a stricter definition of "profit" is applied (to include depreciation as a cost), 63 percent of the renewal salmon fishermen had unprofitable operations. The difference between the 53 and 63 percent figures is the 10 percent who had gross returns sufficient to cover "out-of-pocket" costs but not depreciation. When the definition of profit includes the opportunity cost of capital, 72 percent had unprofitable operations and only 28 percent could show a profit.

In contrast to specialized salmon fishermen, half or more of the fishermen in the other types of fishing had business enterprises which were clearly profitable in 1972. The highest percentages of profitable enterprises were among drag fishermen (81 percent) and salmon-tuna/crab fishermen (79 percent).

PRODUCTION FUNCTIONS OF COMMERCIAL FISHERIES

This section deals with the estimation of production functions. The production function is a relationship between output (gross returns) and resources. The following production function was employed:

$\log y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4$

where y = gross returns in dollars
x_1 = boat capital in dollars (i.e., market value of boat and gear)
x_2 = operating capital in dollars
x_3 = fishing days, and
x_4 = commercial fishing experience in years (a proxy for management input).

The estimation of the parameters of the production function was accomplished by the least-squares regression method. The elasticities of production, b_i (regression coefficient), indicate the percentage by which returns would increase with a 1 percent increase in use of a particular resource. As an illustration, column two of Table 6 indicates that the elasticity of production with respect to fishing days was 0.885 for renewal salmon fishermen. A 1 percent increase in fishing days would bring about an increase of 0.885 percent in gross returns of renewal fishermen if other inputs are held constant. Similarly, an increase in fishing years by 1 percent would lead to an increase in gross returns of renewal salmon fishermen by 0.311 percent. Thus, the most important explanatory variable for renewal salmon fishermen's gross re-

turns was fishing days. The same can be said for entry salmon fishermen.

Operating capital made the most significant contribution to the determination of gross returns for salmon-tuna and salmon-tuna/crab fishermen, while boat capital made the most significant contribution to draggers' gross returns. Interestingly, regression coefficients for boat capital were only statistically significant in the drag fishermen's equation. This suggests that trawler operations at larger scale levels may be more productive.

TOTAL INCOMES OF COMMERCIAL FISHERMEN

Some commercial fishermen have two sources of income: fishery and nonfishery. Nonfishery income includes money received by the skipper and other family members for working outside the fishery, e.g., Social Security payments, interest, rent, etc. Net fishery income is measured as gross returns less total costs (including depreciation) of the fishing business. This is the amount available for the fisherman's living expenditure and investment in his fishery. This net fishery income was added to nonfishery income to obtain total family income.

The average net fishery income of five types of fishermen without nonfishery employment were much higher than that of four types of fishermen with nonfishery employment. Table 7 also indicates that full-time skippers had higher total costs and gross returns than those of part-time skippers. Thus, the high net fishery income of full-time fishermen was due to their high capital investment and large catches.

Renewal salmon fishermen with nonfishery employment reported the highest nonfishery income, averaging $11,639 per family. About 70 percent of this amount came from the skipper's employment outside the fishery. Most of the full-time fishermen received less than $3,000 in nonfishery income. The families of those crab fishermen who did not work outside the fishery, however, averaged over $11,000 from nonfishery income, primarily due to other family member's labor incomes.

Table 7.—Average income of Oregon's commercial fishermen, 1972.

Item	Fishermen without nonfishery employment				
	Renewal salmon	Crab	Salmon-tuna	Salmon-tuna/crab	Drag
Sample size	8	6	10	14	15
Fishery income ($):					
Gross returns	3,848	33,376	15,505	39,830	73,641
Total costs	3,200	21,542	8,733	25,947	45,507
Net fishery income	648	11,834	6,772	13,883	28,134
Nonfishery income ($):					
Skipper's labor income	0	0	0	0	0
Other family members' labor income	463	9,077	1,148	2,894	2,229
Other nonfishery income[1]	4,608	2,418	1,286	302	668
Total nonfishery income	5,071	11,495	2,434	3,196	2,897
Total family income[2]	5,719	23,329	9,206	17,079	31,031

	Fishermen with nonfishery employment			
	Renewal salmon	Entry salmon	Exit[3] salmon	Salmon-tuna
Sample size	59	11	8	11
Fishery income ($):				
Gross returns	1,994	1,322	0	7,609
Total costs	2,149	1,611	0	7,246
Net fishery income	−155	−289	0	363
Nonfishery income ($):				
Skipper's labor income	7,981	9,736	8,344	6,270
Other family members' labor income	2,737	380	1,203	2,261
Other nonfishery income[1]	921			2,176
Total nonfishery income	11,639	10,116	9,547	10,707
Total family income[2]	11,484	9,827	9.547	11,070

[1]Includes Social Security payments, unemployment compensation, interest, dividends, rent, etc.
[2]Total family income = net fishery income plus total nonfishery income.
[3]Income for 1971.

The average family incomes of nine types of fishermen differed considerably. Those renewal salmon fishermen who did not work outside the fishery had the lowest total family income ($5,719); their major sources of income included Social Security and other retirement income. Drag fishermen had the highest total family income ($31,031); a major contributing factor was fishing success.

The fishermen who had some nonfishery employment had an average total family income of $9,500 to $11,500. This corresponds very closely to the average U.S. household income of $11,282 in 1972. Those fishermen who did not report employment outside the fishery had a considerably higher average income than the national average, with the exception of the renewal-salmon and salmon-tuna fishermen.

SUMMARY AND CONCLUSIONS

Specialized salmon fishermen spent less days in commercial fishing than did other types of fishermen. The average number of fishing days for specialized salmon fishermen was between 32 and 40; the average number for crab and combination fishermen ranged from 85 to 148 days. For salmon boats the number of fishing days is the most significant determinant of annual gross returns.

Approximately 63 and 67 percent of renewal salmon and entry salmon fishermen, respectively, had gross returns that were less than total costs. However, only 5 percent of the salmon-tuna/crab fishermen had total costs which exceeded gross returns and about 13 percent of drag fishermen had unprofitable enterprises.

About 85 percent of specialized

salmon fishermen had nonfishery employment in 1972, while only about 20 percent of the crab, drag, and salmon-tuna/crab fishermen worked outside the fishery in addition to fishing. It is apparent that most of the specialized salmon fishermen engaged in commercial fishing on a part-time basis and made most of their income from nonfishery employment.

Drag fishermen received the highest average family income of $31,031. The production function analysis indicated that investment in a large trawler is profitable assuming the environment existing in 1972.

It has to be emphasized that our analysis in this paper is based on 1972 prices and landings in Oregon. In order to make a more meaningful inference on profitability of commercial fishermen over time, it would be necessary to extend our calculations for different seasons.

It is believed that socioeconomic characteristics for the segments sampled are reasonably representative of the industry as a whole. Since most of Oregon's commercial fishermen had nonfishery employment in addition to commercial fishing, development of a fishery management program should consider its potential socioeconomic impact on fishing and nonfishing sectors.

ACKNOWLEDGMENTS

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MFR Paper 1261. From Marine Fisheries Review, *Vol. 39, No. 8, August 1977. Copies of this paper, in limited numbers, are available from D822, User Services Branch, Environmental Science Information Center, NOAA, Rockville, MD 20852. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

Arctic Marine Research Contracts Awarded

Four supplemental research contracts totalling $1,400,264 have been awarded by the National Oceanic and Atmospheric Administration (NOAA) to continue studies under the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The comprehensive studies are being conducted by NOAA's Environmental Research Laboratories (ERL) for the Interior Department's Bureau of Land Management (BLM). They provide environmental data to help managers predict the probable ecological impacts of oil and gas development on Alaska's outer continental shelf. Contract recipients were the University of Alaska, Oregon State University, the Interior Department's U.S. Fish and Wildlife Service, and Western Washington State College. The supplemental contracts bring total funding for those studies to $4,524,319.

The University of Alaska's supplemental contract of $844,119 will help determine the probable ecological impacts of gas and oil exploration and development activities on Alaska's outer continental shelf. Under terms of the contract, staff members with the University's Geophysical Institute in Fairbanks, Alaska, will monitor all scientific research work performed by universities and government agencies in the Beaufort and Chukchi Seas—two of the nine designated petroleum lease areas within Alaska's outer continental shelf area.

These investigations, approximately 60 separate research projects, include baseline studies of the number and kinds of fish, marine mammals, and birds, and smaller organisms which occupy the two Arctic coastal areas prior to oil and gas exploration and development. The research also provides a description of the physical, chemical, geological, and biological factors which influence the coastal environment and marine life in the regions. With the supplemental funds, a total of $1,734,775 has been awarded to the University of Alaska's Geophysical Institute for this work.

Oregon State University in Corvallis received $46,645 in supplemental contract funds to continue research to assess major populations of abundant seafloor species and where they congregate along the bottom of the western Beaufort Sea. The research will take place between 5 and 100 m (16 and 328 feet) depth across the continental shelf adjacent to the Alaska shoreline.

Results of the study will include 200 pairs of underwater photographs illustrating bottom conditions and dominant visible life forms along the specific region of the Arctic sea floor. The research will also yield 115 samples of marine life, collected by the scientists, which will remain in Oregon State's Benthic Invertebrate Reference Museum, and a narrative report of conclusions relating to environments and seafloor organisms sensitive to oil-related activities. Oregon State University had previously received $547,906 from NOAA.

Studies of the seasonal migrations of marine birds, porpoises, and whales

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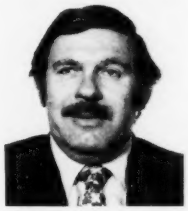
Barrett Named SWFC Director

Izadore Barrett, former Acting Director of the National Marine Fisheries Service's Southwest Fisheries Center, La Jolla, Calif., has been named Director of that facility, NMFS Director Robert W. Schoning has announced. As director of the Southwest Fisheries Center, one of four major Centers in the Service, Barrett's responsibility includes NMFS laboratories at La Jolla and Tiburon, Calif.; Honolulu, Hawaii; and the Pacific Environmental Group, Monterey, Calif. Barrett replaces Brian J. Rothschild who is now the NMFS Director of the Office of Policy Development and Long Range Planning in Washington, D.C.

"Barrett," Schoning said, "is regarded highly as a scientist and administrator and is well qualified to supervise current research on tuna/porpoise, and the economic and biological studies supporting the Pacific and Western Pacific Regional Fishery Management Councils in their allocation of fishery resources.

"There is increasing importance placed on research and scientific information with the new thrust of extended



Barrett

jurisdiction, and it is particularly important to have an experienced, competent scientist to lead the group of trained professionals at the Center."

For the past year, Barrett has been the Acting Center Director. Previously he had been the Deputy Director for 4 years, and assistant Director of the Center's predecessor facility, the Fishery Oceanography Center at La Jolla, for 2 years.

After 11 years as a scientist with the Inter-American Tropical Tuna Commission in La Jolla, Barrett was the United Nations Food and Agriculture Organization (FAO) Advisor for Fisheries to the government of Chile from 1969 to 1970, and Chief Fishery Biologist for the FAO in Santiago, Chile, from 1967 to 1969.

Barrett, who began his new assignment 23 May, was born in Vancouver, British Columbia, where he received a B.A. from the University of British Columbia. He has pursued postgraduate studies at the University of Toronto, and at the University of Washington.

The new Center Director serves on many scientific committees, is a member of a number of professional and scientific organizations, and the author of more than 25 published papers.

along Alaska's coastlines will be continued by the U.S. Fish and Wildlife Service under its $453,800 supplemental contract. As part of the continuing research, Fish and Wildlife Service scientists are compiling detailed descriptions and maps of all known seabird colonies along Alaska's coastal region. The research is a critical part of the OCSEAP marine bird studies since petroleum development on the shelf is likely to have a more pronounced effect on individual bird colonies rather than on the general seabird population.

In related work, scientists are making special surveys of marine bird habitats in the Gulf of Alaska, the Chukchi Sea, and the southern and northern Bering Sea. The northern Bering Sea between Cape Newenham and the Bering Strait is of special significance because four National Wildlife Refuges border the coastline there.

Prince William Sound is the site of a separate research project. From this study a comprehensive tabulation of seasonal populations and habitats of porpoises and whales making their annual migrations between tropical waters and the Arctic foraging regions will be compiled. Results of the study will include maps illustrating survey routes and seasonal population distribution patterns of the humpback, fin, minke, and killer whales, and the dall and harbor porpoises. Previous research has shown that porpoises detect new activity in an area and if the disturbance (such as petroleum development activity) persists, the animals may abandon the region. With the supplement funds, a total of $1,795,964 has been awarded to the U.S. Fish and Wildlife Service for research studies during the past 2 years.

Western Washington State College in Bellingham, Wash., has received supplemental contract funds of $55,700 to continue research on plant and animal life along Alaska's Arctic coastline. The principal purpose is to portray the habitats and ecological relationships of plants and animals which live along the shorelines of the Beaufort and Chukchi Seas.

To carry out the research, Carter Broad and his co-workers at Western Washington State College are sampling key sites from Point Barrow east to the Canadian border and southwest to Kotzebue and Cape Prince of Wales as part of research begun in the summer of 1975. Results of the research will include comprehensive maps showing the types of bird, mammal, fish, and plant life which inhabit the shorelines of these portions of the Arctic Ocean and estimates of predominant marine life populations there.

Data from the extensive study will also help NOAA's Environmental Research Laboratories determine background levels of petroleum found in marine plant and animal life along the specific shorelines as well as the recovery rates of Arctic shoreline communities after disruptions from chemical and mechanical disturbances. The research should also supply answers concerning the community structure and reproductive activities of marine life inhabiting the shoreline and to what extent migrant or casual visitor species feed in the shallow-water and beach communities. Western Washington State College previously received $343,329 from NOAA.

Fin Erosion Disease in Flounder, Sole Studied

California scientists are trying to learn whether sole and flounder are the hapless victims of municipal waste discharges into west coast and northeast U.S. waters under a grant from the National Oceanic and Atmospheric Administration (NOAA). The $39,200 award was made to the Southern California Coastal Water Research Project Authority in El Segundo by the Commerce Department agency's Environmental Research Laboratories in Boulder, Colo. The principal effort is to determine whether fin erosion disease among starry flounder and Dover sole along the west coast and winter flounder on the east coast may have a common cause related to the discharge of toxic wastes from three municipal regions.

To find the answers, the California fish biologists will measure levels of selected trace contaminants in diseased fish from the Duwamish River Estuary in Seattle's harbor, the Palos Verdes coastal shelf near Los Angeles, and the Sandy Hook-Raritan Bay area of the New Jersey-New York harbor.

If the trace contaminant levels in the fish are significantly high, the researchers will compare them with the levels found in bottom sediments in each of the three municipal regions to determine whether contaminant levels in the fish and in each of the three areas are comparable.

The California team also will compare trace contaminants in the tissues of diseased fish from the polluted areas with apparently unaffected fish from the same areas, and unaffected fish from control sites—relatively unpolluted waters within the same general regions. The control sites are off Dana Point in southern California, the Nisqually River estuary in Washington State's Puget Sound, and off Great Bay, N.J. Joel O'Connor, an oceanographer with NOAA's Marine Ecosystems Analysis New York Bight project office at Stony Brook, N.Y., will be monitoring the research.

Funds Awarded to Study East Coast Fish Kill

Grants totaling more than $220,000 have been awarded by the National Oceanic and Atmospheric Administration (NOAA), for university research into the role of the tiny drifting marine plants called phytoplankton during the fish kill off New Jersey's coast last fall. The grants went to New York's Columbia University, New Jersey's Rutgers University, and Maine's Bigelow Laboratory for Ocean Science from the Commerce Department agency's Environmental Research Laboratories of Boulder, Colo.

Rutgers' Center for Coastal and Environmental Studies Marine Sciences Division in New Brunswick received $85,000, Columbia's Lamont-Doherty Geological Observatory, $70,436, and Bigelow Laboratory at West Boothbay Harbor, Me., $65,730. In a cooperative research effort with NOAA's Marine

Ecosystems Analysis (MESA) New York Bight Project, the grant recipients will assist in the study of the marine conditions which led to the fish and shellfish kill, and lowered oxygen levels in water layers near the ocean floor. Results of the research will provide MESA scientists a better understanding of the marine processes and inhabitants most influential to the crucial oxygen levels.

International Fisheries Data Provided by ASFIS

The increasing importance of marine and freshwater resources to the economic growth of nations has led to an ever-increasing flood of published information in the pertinent sciences, according to Joseph F. Caponio, Director of the Environmental Science Information Center (ESIC), a branch of the National Oceanic and Atmospheric Administration's (NOAA) Environmental Data Service (EDS). As the literature expands, says Caponio, so do the problems of the scientists, technologists, and administrators, whose responsibility it is not only to keep abreast of developments in the field but also to sift through larger and larger quantities of published data in search of complete and reliable information on specific items of study.

By the early 1970's, many countries and institutions had come to realize that no single government or private institution has the personnel or funds to examine all aspects of the global marine and freshwater environments. Only an integrated system of information exchange, coordinated by an international body, can successfully carry out this enormous task.

It was in response to this need for international collaborative effort that the Food and Agriculture Organization (FAO) and the International Oceanographic Commission (IOC) began, in 1973, serious talks and official actions to create an international computer-oriented information system. The Aquatic Sciences and Fisheries Information System (ASFIS) became a reality in September 1975, when the First Session of the Joint FAO/IOC Panel of Experts on ASFIS was held to formulate policy and guidance for development of ASFIS products and services.

Today, ASFIS centers in Canada, France, West Germany, United Kingdom, United States and USSR cooperate with the two parent bodies by scanning, selecting, indexing, and abstracting literature originating in their respective countries or published in their languages, says Caponio. The literature they put into the system comes from 4,500 serial journal titles, reports, books, monographs, pamphlets, and information from seminars, workshops, and conferences all over the world.

The ASFIS coordinating center in FAO is responsible for collecting, organizing, and processing bibliographic data and abstracts received from the centers, and for making the total data base available to the scientific community. Products and services currently being offered by ASFIS include the five items below.

1) *Marine Science Contents Tables* is a monthly pamphlet that reproduces the tables of contents of the world's leading marine science journals and gives details of future marine science meetings. Over 3,000 copies of this pamphlet are circulated each month. (Free.)

2) *Aquatic Sciences and Fisheries Abstracts* is a monthly journal, including an annual cumulative index. ($250 per year.) Monthly issues contain about 1,200 abstracts arranged for direct and cross reference. Journal issues also contain book notices; notices of the availability of translations; and monthly geographic, taxonomic, and author indexes. The annual index is divided into three parts—subject, taxonomic, and geographic—and fully cross-referenced. The literature scanned in ASFA includes journals, reports, unpublished documents, books, monographs, and translations, from over 20 countries. An ASFA abstract appears in 20 weeks or less after original publication of an article.

3) ASFA Related Tape Services. Since 1 January 1975, ASFA indexes have been generated from computer input prepared at the FAO Coordinating Center. An experimental semiannual index for the first half of 1975 was produced in Germany for the FAO and is available in the United States through EDS efforts. Users of the Dialog online information retrieval service operated by the Lockheed Corporation in Palo Alto, Calif. can access ASFA as "File 44." Others who wish searches of ASFA may arrange for them through any EDS Center that services OASIS (Oceanic and Atmospheric Scientific Information System) requests.

Tapes of bibliographic and indexing data for the 1976 and 1977 ASFA input will be available late this year. Starting in January 1978, the entire ASFA data base (bibliographic captions, abstracts, and index entries) will be available in tape format.

4) *ASFIS World List of Periodicals in Marine and Freshwater Science*. (Free.) The Fisheries Department of the FAO compiles a listing of bibliographic details of serial publications. A preliminary edition in 1976 listed 1,200 key titles, including for each one the abbreviated title as used in ASFA, text, and language of summaries. A new list of 600 titles will be added this year, and regular updates will be prepared.

5) *ASFIS Register of Experts and Institutions*. (Free.) Inquiries to individuals in 100 countries have culminated in a directory of 700 institutions and 12,000 experts in specific fields of aquatic science. The Register is to be published this year.

Products listed above as "Free" may be ordered from the Research Information Unit, Fishery Resources and Environment Division, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy. *Aquatic Sciences and Fisheries Abstracts*, with its associated index, may be ordered from Information Retrieval, Inc., 1911 Jefferson Davis Highway, Arlington, VA 22202.

Individuals wishing additional information about ASFIS products and services may call or write to the ASFIS center for the United States: Joseph F. Caponio, Director, Environmental Science Information Center (D8), Environmental Data Service, National Oceanic and Atmospheric Administration, 3300 Whitehaven Street, N.W.,

Washington DC 20235 (telephone, 301-443-8287, ask for James Stear).

Continuing development of ASFIS will be decided upon by the legislative bodies of the IOC and the FAO, following advice provided by the Joint Panel of Experts. Substantial financial support has been provided by the United Nations Environmental Programme so that the system can be expanded to cover larger language, disciplinary, and geographical areas. Necessary to such expansion, as recognized by the Joint Panel at its Second Session in October 1976, is the training of information specialists. As a first step, the FAO and IOC will hold a workshop in 1978 to instruct documentalists in ASFIS centers on the techniques needed for participation in the system. Both Mexico and Portugal have indicated their intention to begin participation within the next 2 years. The long range plan includes establishment of ASFIS centers and referral offices in most marine nations, so scientists everywhere will have a local point of contact for information and assistance.

U.S. Fishery Market Forecasts Readied

A revised 10-year forecast of U.S. supply and demand for fish will soon be made available by the Commerce Department's National Oceanic and Atmospheric Administration (NOAA).

The forecast will update a prior forecast issued in 1975, and will be based on a model developed earlier by Synergy, Inc.[1], a Washington-based consulting firm, under contract to the National Marine Fisheries Service, a NOAA agency. Synergy is under contract to participate in the current effort.

The Synergy model produces national market "baseline" forecasts of annual supplies, demand, and average prices for 11 fishery markets, such as, groundfish, shrimp, and salmon. A "baseline" forecast assumes that existing trends and conditions—the "status-quo"—remain in effect. The model also can be used to predict the market impact of changes in fisheries supply and demand that may result from assumed biological changes in fisheries, political and other policy decisions, or turns in the general economy.

Part of the $9,988 contract, awarded by NMFS to Synergy, will test the market impact of questions pertaining to the regulation of domestic and foreign fishing within the newly declared (1 March 1977) U.S. 200-mile fishing zone. Additionally, Synergy will expand the national model into a global forecasting model that will predict future world fish prices for selected market categories.

[1]Mention of commercial firms or trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Marine Pollutants Gauged Off New York, New Jersey

The National Oceanic and Atmospheric Administration has awarded a $58,900 research grant to the University of South Florida to make chemical studies of the trace-metal pollutants off the New York-New Jersey coast. The award was made to the Department of Marine Science in St. Petersburg by the Commerce Department agency's Environmental Research Laboratories in Boulder, Colo. The university study is a cooperative research effort with NOAA's Marine Ecosystems Analysis (MESA) New York Bight Project—an extensive environmental study to assess the impact of human activity on the region's marine environment. As part of INSTEP, the Inner Shelf Sediment Transport Experiment, the research will evaluate the types of sediments moving along Long Island near-shore areas by identifying their sources, pattern of movement, and some of the major reactions associated with them including transfer of pollutants to the area.

The Southern Florida researchers, directed by Peter Betzer, plan to collect bottom sediment samples and samples of suspended particulate matter from turbid and relatively clear waters along the south shore of Long Island during different seasons of the year. By analyzing the chemical and mineralogic composition of these particulate and sediment samples, the university scientists can help geologists describe how geological, biological, and man-made solids are deposited, eroded, and transported. At the same time, the scientists will analyze such dumped materials as sewage sludge, dredge spoil, and waste acid to determine their trace-metal composition, and to evaluate their role as pollutants in the study area. Results of the research will be used by environmental engineers who are concerned with problems of water quality or municipal waste disposal or the placement of offshore nuclear power plants.

Donald Atwood, director of the Ocean Chemistry Laboratory at NOAA's Atlantic Oceanographic and Meteorological Laboratories in Miami, Fla., is monitoring the research. The grant program of NOAA's Environmental Research Laboratories both complements and supplements research performed in the laboratories by awarding grants in the environmental sciences to nonprofit organizations or institutions of higher education whose primary purpose is scientific research.

Fee Changes Proposed in Vessel Financing Program

An increase in fees paid under the Fishing Vessel Obligation Guarantee program has been proposed by the Commerce Department's National Marine Fisheries Service. The program provides Federal guarantees of obligations financing or refinancing up to 75 percent of the cost of building, reconstructing, or reconditioning U.S. fishing vessels. The rise in fees is proposed in amendments to regulations governing the program.

Since October 1976, the cost of administering this program, previously paid with funds annually appropriated

by Congress, has been paid from the Federal Ship Financing Fund, now lacking enough revenue. Fees paid by those receiving guarantees are deposited in the Fund, which serves as a reserve for redeeming guaranteed obligations in default.

The amendments provide an increase in the Guarantee Fee (annual fee based on unpaid principal balance of guaranteed obligation) from ½ to ¾ of 1 percent. The Filing and Commitment Fee (a one-time fee based on initial principal amount of obligation to be guaranteed), previously ½ of 1 percent of the first $100,000, and ¼ of 1 percent of the next $200,000, will be increased to ½ of 1 percent of the first $300,000 and ¼ of 1 percent of the remaining balance.

One-half of the total amount of the new filing and commitment fee would be due as a filing fee at the time of application and is non-refundable. The other one-half of the new total amount would be due as a commitment fee when the application is approved and the Secretary's Commitment is issued.

A filing fee is established for the first time regarding refinancings and assumptions of previously guaranteed obligations at ¼ of 1 percent of the unpaid principal balance. This fee must accompany the application for refinancing or assumption and will be retained by the Secretary.

Comments should be submitted to Michael L. Grable, Chief, Financial Assistance Division, National Marine Fisheries Service, NOAA, Washington, DC 20235. Telephone (202) 634-7496.

Foreign Fishing Vessel Tally Below 1976 Level Off the U.S. Coastlines

The number of foreign fishing vessels sighted off the U.S. coasts in April rose slightly over the March number but remained 58 percent lower than the number sighted in April 1976, according to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service.

Preliminary reports from the Department of Commerce agency showed 235 foreign fishing and fishing support vessel sightings off U.S. coasts during April, compared to 560 vessel sightings in April 1976.

The Foreign vessels were sighted off the coasts of New England, Alaska, the Pacific Northwest, and in the Gulf of Mexico. The ships were from 4 nations, compared to 11 nations a year ago.

The decline in the number of foreign fishing vessels off U.S. shores is due to the implementation of the Fishery Conservation and Management Act. Since 1 March, foreign nations desiring to fish off U.S. coasts must obtain permits to fish for certain species. Restrictions under the Act include quotas on species and limitations on fishing in specified areas.

The April counts were made by representatives of the National Marine Fisheries Service and by personnel of the U.S. Coast Guard, conducting joint fisheries enforcement patrols from Coast Guard aircraft and cutters.

The largest number of foreign fishing vessels, 144, was from Japan which had 103 vessels fishing for pollock off Alaska and 41 vessels in the Gulf of Mexico fishing for bluefin tuna. The Soviet Union had 66 vessels, 34 off New England fishing for hake and 32 catching pollock in Alaskan waters. Canada had 23 salmon vessels off the Pacific Northwest, and South Korea had two vessels fishing for sablefish off Alaska.

Because tuna do not come under the 200-mile bill, permits were not required for Japan's 41 longline vessels fishing for bluefin tuna in the Gulf of Mexico.

Drought Causes Saltier Water in Puget Sound

Puget Sound is saltier these days, and this winter's drought is the probable culprit, according to scientists with the National Oceanic and Atmospheric Administration (NOAA). The shortage of rainfall in the Pacific Northwest, according to Glenn Cannon of the Pacific Marine Environmental Laboratory, has reduced the amount of fresh water flowing into the Sound to mix with the ocean's salty waters.

Cannon and Norman P. Laird of the NOAA Seattle Laboratory (one of the Commerce Department agency's Environmental Research Laboratories) discovered an increase in water density—mostly salinity—during an oceanographic study of the Sound in March. The research was part of a larger study of Puget Sound being managed by NOAA'S Marine Ecosystems Analysis (MESA) program. The results of measurements of salinity and temperature throughout the Sound have not all been analyzed fully yet, Cannon said, but so far they reveal higher-than-normal levels of salinity.

A similar increase in salinity was recorded in 1953. "We haven't made a systematic comparison of the weather conditions then and now," Cannon said, "but we have learned there also was a similar dry spell during the 1952-53 winter." He added that in that instance the waters returned to normal the following year.

The focus of the March voyage was the deep water of the Sound. Puget Sound, cut ages ago by glaciers, is actually a series of deep basins, separated from each other, and from the Pacific, by "sills" of shallower bottom. Lowering their instruments on a cable, Cannon and Laird made measurements at depths down to 1,000 feet (300 m).

The researchers also deployed current meters and other instruments at The Narrows near Tacoma, where the estuarine waters of the Sound flow over a sill into a secondary basin to the south. Tidal currents through The Narrows are extremely strong, according to Cannon, and they exert a sort of pumping action, drawing deeper water from the northern basin and contributing to renewal of the deep water in Puget

Sound. When these instruments are recovered, the researchers hope they will reveal something about the nature of this pumping mechanism.

Cannon was to repeat the salinity measurements in May and June to see if the increased salinity persisted. On those cruises, and on another in the fall, he also intends to study Admiralty Inlet, where ocean waters enter the Sound over another sill. Processes there determine when denser (either saltier or colder) water from the Pacific crosses the sill and enters the Sound.

U.S. Fishery Import Detentions Set At $15 Million in 1976

The United States detained fishery imports valued at more than $15 million at U.S. ports of entry during 1976, according to the NMFS Office of International Fisheries. Fishery imports from 45 different countries were detained for reasons which included short weight, improper labeling, decomposition, the presence of filth, bacterial contamination, or other violations of U.S. laws and regulations.

United States imports of edible fishery products totaled $1.9 billion in 1976. While familiar major trading partners such as Canada, Japan, and Mexico each provided fishery imports worth more than $200 million to the United States, other countries in Asia, Europe, Latin America, and Oceania were also significant sources of fishery imports. Shipments from Asia, for example, were worth more than $451 million.

Over two-thirds of all 1976 detentions were shipments originating in Asia (Table 1). Five nations accounted for 55 percent of all detentions (Table 2). Four of the five were developing countries in Asia. Fishery products from the Republic of China (Taiwan), India, Bangladesh, and Hong Kong worth a total of about $7.2 million accounted for most of these detentions. These imports were detained for reasons including decomposition, salmonella contamination, inadequate labeling, presence of live insects, short weight, excessive mercury content, and failure of manufacturers of products with low acid contents to register processing procedures. Those fishery imports from the Federal Republic of Germany which were detained were all detained for inadequate labeling, not for sanitary violations.

While the value of fishery imports detained in 1976 was about $15 million, this was less than 1 percent of the value of all U.S. edible fishery imports in that year (Table 3). Canada, Japan, Mexico, and most other countries which were leading suppliers of U.S. edible fishery imports in 1976 had a very low percentage of their fishery products detained. Among the top 12 suppliers of U.S. fishery imports, only India, Panama, and the Republic of China had rates of detention higher than the 1976 world average.

A complete listing of U.S. detentions of fishery imports by country, company, quantity, value, and reason is available from NMFS Statistics and Market News Offices. Please request the list attached to IFR-77/77 "U.S. Detentions of edible fishery imports, 1976," enclosing a self-addressed mailing label.

Table 1.—Value (in US$1,000) of U.S. detentions of edible fishery imports by region, 1976.

Region	Value
Asia	10,121.9
Latin America	2,212.2
Canada, Europe	2,014.7
Middle East	511.5
Africa	159.1
Oceania	31.0
Total	15,050.4

Source: "Commercial Import Detentions, 1976." Food and Drug Administration, U.S. Department of Health, Education, and Welfare.

Table 2.—Value (in US$1,000) of U.S. detentions of edible fishery imports, by selected countries, 1976.

Country	Value
Rep. of China	2,858.0
India	1,711.0
Bangladesh	1,566.7
Fed. Rep. of Germany	1,071.8
Hong Kong	1,035.5
Other	6,807.4
Total	15,050.4

Source: "Commercial Import Detentions, 1976." Food and Drug Administration, U.S. Department of Health, Education, and Welfare.

Table 3.— Value (in US$1,000) of U.S. detentions of edible fishery imports, by major trading country, and percentage detained in 1976.

Country	Value		Percent detained
	Imports[1]	Detentions[2]	
Canada	374,532.0	85.1	negl.[3]
Japan	212,426.0	873.7	0.4
Mexico	200,024.0	443.1	0.2
Norway	70,870.0	8.2	negl.
Denmark	60,250.0	1.8	negl.
India	57,046.0	1,711.0	3.0
Australia	56,172.0	25.0	negl.
South Africa	50,888.0	69.6	0.1
Korea, Republic of	50,823.0	138.1	0.3
Panama	48,158.0	491.9	1.0
China, Republic of	46,059.0	2,858.0	6.2
Brazil	42,715.0	131.5	0.3
Other	591,440.0	8,213.4	1.4
Total	1,861,403.0	15,050.4	0.8

[1]Source: Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. *"Fisheries of the United States, 1976."*
[2]Source: U.S. Department of Health, Education, and Welfare, Food and Drug Administration. *"Commercial Import Detentions,* 1976."
[3]Less than 0.05 percent.

LOS Institute Moves

A $22,500 Sea Grant has been made to the University of Hawaii for the establishment there of the Law of the Sea Institute, formerly at the University of Rhode Island. The funds from the Department of Commerce's National Oceanic and Atmospheric Administration will be matched by $17,111 in university funds.

The Institute, at the University of Rhode Island since 1966, is being relocated because of a shift in emphasis from international to domestic issues involving the sea at the New England institution.

The Law of the Sea Institute conducts international meetings and conferences, publishes studies and monographs, and serves as a data bank and information center for those interested in legal and policy problems concerning the sea. The University of Hawaii was chosen as the new site following a review of several institutions which had volunteered to continue the operation of the Institute.

EEC Fisheries Budget Increases 45 Percent

The European Economic Community (EEC) has increased the fisheries sector of its 1977 General Budget to $16.8 million, an increase of 45 percent over the $11.6 million appropriation of 1976 (Table 1). Fishery appropriations represent one quarter of one percent of the EEC's 1977 agricultural budget of $7.084 billion. Approximately three-quarters of the EEC budget has been spent in recent years on agricultural programs.

About one-third of the fisheries budget will be for joint schemes of conversion in the inshore fishing sector. This is a significant increase over 1976 and reflects the EEC's desire to emphasize fishing within the Community's 200-mile zone rather than in distant waters, especially in the fishing zones of third countries. It should also be noted that, in the category of joint schemes, the EEC has eliminated all funds for conversion in the cod fishing sector. The fisheries budget clearly discourages any increased fishing effort for this overfished species.

Another third will be for "withdrawal" and "buying-in" of fishery products. Both of these programs are pricing mechanisms whereby the EEC intervenes to correct imbalances between supply and demand and to maintain minimum prices. The withdrawal price is the price at which the Community intervenes to divert excess fish supplies in the human consumption market to the animal feed market. Buying-in is another form of intervention in which national agencies are required to purchase fishery products when their price falls below the intervention price.

The last third of the amount appropriated to the fisheries budget will be divided between refunds on fishery exports and aid for private storage of fishery products. The budget for refunds for fishery exports is less than half the appropriation for 1976. With prices for fishery products generally high in the EEC and with significant shortages of certain species, such as herring and some groundfish, the Community has decided to deemphasize export subsidies.

Fishery allocations of the EEC General Budget are included in the European Agricultural Guidance and Guarantee Fund. Titles 6 and 7 of the fund are part of the Guarantee Section and Title 8 belongs to the Guidance Section. Complete figures on the EEC's 1977 General Budget are found in the *Official Journal of the European Communities*.

Table 1.—Fisheries in the general budget of the European Communities for the financial year 1977[1]. Data is listed in US$1,000[2].

Item	Expenditure 1975[3]	Appropriations 1976	Appropriations 1977
Chapter[4]71			
Refunds on fishery products	3,472.6	5,600.0	2,240.0
Intervention in respect of fishery products			
Withdrawal and buying-in	4,393.5	2,240.0	2,240.0
Aid for private storage	3,722.9	1,112.0	3,360.0
Total	8,116.4	3,360.0	8,960.0
Chapter 71 total	11,589.0	8,960.0	11,200.0
Chapter 83 Joint schemes[5]			
Conversion in the codfishing sector	3,245.9	1,456.0	—
Conversion in the deep sea fishing sector	—	token entry	
Conversion in the inshore fishing sector	—	token entry	5,600.0
Total	3,245.9	1,456.0	5,600.0
Chapter 89 Special measures[5]			
Group of producers in the fisheries sector	3,775.0	1,120.0	
Grand total	14,872.6	11,563.0	16,800.0

[1]*Official Journal of the European Communities*, 20(L 79).
[2]Converted to U.S. dollars; one unit of account equaling $1.25 in 1975 and $1.12 in 1976 and 1977.
[3]May not add due to rounding.
[4]Titles 6 and 7, European Agricultural Guidance and Guarantee Fund, Guarantee Section.
[5]Title 8, European Agricultural Guidance and Guarantee Fund, Guidance Section.

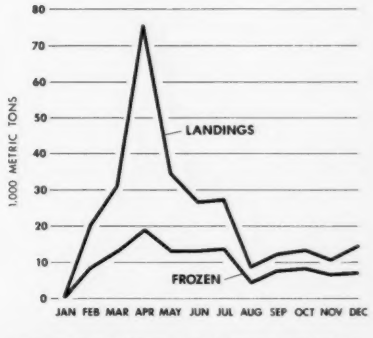
NORWEGIAN COD LANDINGS TOLD

The total Norwegian cod landings for 1976 were 275,000 metric tons (t), an increase of 49,000 t or 18 percent from 1975. Landings peaked in April (see figure below) due to the annual spring

Norwegian cod production in metric tons for 1976, by month and selected commodity. Source: *Fisketsgang*.

Month	Commodity Fresh	Frozen	Other[1]	Total
January	231	26	123	380
February	1,497	8,587	10,075	20,159
March	1,705	13,263	16,295	31,263
April	2,155	18,915	54,302	75,372
May	1,143	13,196	20,082	34,421
June	833	13,068	12,763	26,664
July	694	13,615	12,817	27,126
August	466	4,192	4,133	8,791
September	447	7,758	4,051	12,256
October	1,065	8,179	4,132	13,376
November	899	6,511	3,259	10,659
December	1,402	6,993	6,133	14,528
Total	12,527	114,303	148,165	274,995

[1]Includes salted and smoked cod.



Norwegian cod landings and frozen cod production for 1976 in 1,000 metric tons (landed weight). Source: *Fisketsgang*.

migration but fell during August as the cod left Norwegian waters. As in previous years, Norwegian fishermen switched from cod to other species during the summer months, accounting for the decreased cod landings.

About 5 percent of the total Norwegian 1976 cod landings were market fresh, 42 percent frozen, and 53 percent salted or smoked. In contrast to 1975, these figures demonstrate an increase of salted and smoked cod production and a corresponding decrease of frozen production, while the percentage of cod marketed fresh remained the same. United States imports of frozen Norwegian cod blocks and fillets totaled 19,960 t in 1976. (Source: IFR-77/80.)

For annual statistics on 1976 cod landings and their utilization in fresh, frozen, salted, and smoked forms, and a chart showing 1976 landings fluctuations, send two pre-addressed mailing labels to: W.L. Rodgers (F411), Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235.

Fishing Vessel Seizures Noted Around the World

The most important fishing vessel seizures and related incidents from September 1976 to April 1977, listed below, were compiled by the NMFS Office of International Fisheries, International Fisheries Analysis Branch.

SEIZURES BY THE UNITED STATES

The U.S. released the Republic of Korea (ROK) longliner *Kwang Myong No. 21* on 23 December, 1976, after the Korea Wonyang Fisheries Company paid $415,000 in civil penalties. The ROK vessel was seized 3 September, 1976, after a boarding party discovered tanner crab in storage freezers.

The Japanese longliner *Fukuyoshi Maru No. 75* was seized by the United States on 20 January, 1977, for retaining tanner crab. After the vessel's owner paid civil penalties of $250,000, the vessel departed U.S. waters on 9 February.

The Soviet trawler *Taras Shevchenko,* which was seized 10 April for violating the U.S. 200-mile fishery zone regulations, left Boston harbor on 5 May to resume fishing off New England. The vessel was released following the payment of a $240,000 fine.

SEIZURES OF U.S. VESSELS

The Brazilian Navy seized a U.S. shrimp trawler, the *Cayenne Laura,* on 9 January for fishing out of season and for inadequate documentation in violation of the shrimp agreement with Brazil. The Navy confiscated 2 metric tons (t) of fish and 0.6 t of shrimp, to be auctioned in Belem.

Costa Rican authorities seized the U.S. tuna baitboat *Tradition* while it was in port at Puntarenas. The Costa Rican action was reportedly due to claims of personal injury by crew members who were Costa Rican nationals.

The U.S. shrimp trawler *Voyager* was seized by the Brazilian Navy on 22 April for illegally fishing in the shrimp agreement area.

SEIZURES BY BRITAIN

The British government announced on 9 May, in reply to a House of Lords request, that between 1 January and 30 April 1977, a total of 11 foreign fishing vessels (listed below) were convicted of offenses against British Sea Fisheries laws while fishing inside the United Kingdom's 200-mile fishing zone.

The French trawler *Guynemer* was seized by the U.K. frigate HMS *Hardy*. The skipper, Pierre Coppyn, who pleaded guilty on 18 April in a British court to a violation of net regulations under the Northeast Atlantic Fisheries Commission Conservation Agreement, was fined £250, had to pay £100 for court costs, and had his gear, worth £3,000, confiscated.

OTHER SEIZURES

Venezuelan authorities seized 9 Trinidadian fishermen on 27 November 1976, for operating in Venezuelan-claimed waters. The fishermen were given back their vessel and released on 30 November; no fines were imposed. Venezuela and Trinidad and Tobago have been engaged in bilateral fishery negotiations.

Moroccan authorities have reportedly seized several Spanish fishing vessels (and possibly a Portuguese vessel) which were fishing off the Moroccan coast during November 1976. The reason for the seizures has not been reported.

Burma seized a Thai fishing vessel on 14 November 1976, for violating Burmese-claimed waters in the Gulf of Martaban. The Thai Government formally protested the seizure to the Burmese Ambassador on 22 November, asserting that the fishing vessel was in international waters at the time of seizure.

Indonesia seized a Taiwanese fishing vessel at the end of November 1976 for fishing in Indonesian-claimed waters without a license.

British fishing vessel seizures, 1 January-30 April, 1977.

Date	Nationality	Vessel	Offense	Penalty
23 Jan.	Faroese	Purse seiner	Fishing outside designated area	Fined £20,000
24 Feb.	Danish	Trawler	Fishing outside designated area	Fined £2,500, catch confiscated
24 Feb.	Danish	Trawler	Fishing outside designated area	Fined £2,500, catch confiscated
25 Mar.	Dutch	Beam trawler	Landing immature fish	Fined £200, £81 costs immature catch taken
7 Apr.	Russian	Trawler	Fishing without a licence	Fined £10,000; gear, catch confiscated
10 Apr.	Danish	Trawler	Using undersized net	Fined £1,000, gear confiscated
13 Apr. 13 Apr.	Spanish Spanish	Pair trawlers	Fishing outside designated area	Each skipper fined £10,000; gear, catch confiscated
16 Apr.	French	Trawler	Using undersized net	Fined £250, £100 costs part of net confiscated
28 Apr. 28 Apr.	Spanish Spanish	Pair trawlers	Fishing outside designated area	Each skipper fined £15,000; gear, catch confiscated

Mauritania seized a Japanese trawler for violating the African nation's territorial waters during the first week in January 1977. The Kyokuyo Company which owns the vessel stated on 5 January that the trawler was still in custody.

Nicaragua seized 10 Honduran fishing vessels on 10 January 1977, for reported illegal fishing in Nicaraguan territorial waters along the Caribbean coast.

The Soviet Union seized the Japanese small trawler *Taihei Maru No. 53* (124 GRT) on 3 February for allegedly operating in Soviet waters off Siberia. The Japanese vessel was released after paying a fine of $11,900 on 10 February.

Bangladesh seized two Thai fishing trawlers with 43 crewmen on 4 February. The two vessels were operating in Bangladesh-claimed territorial waters, according to a Bangkok newspaper.

Trinidad and Tobago's Coast Guard seized two Venezuelan fishing trawlers on 5 February while they were transferring their shrimp catch off the northwestern coast of Trinidad. The trawlers were escorted to Point Fortin where Trinidad authorities questioned the crew and warned them about further violations. The two vessels, *Iazaro* and *Giulio Cesare,* were then released.

Japan seized a 15-GRT Republic of Korea fishing vessel on 13 February in waters off southern Japan for operating inside the 3-mile limit.

Costa Rican fishermen reported that, while operating in Costa Rican waters, they were fired on by unidentified individuals from Nicaraguan vessels on 15 February.

Soviet naval vessels on 23 February fired on 12 Turkish trawlers fishing off the Turkish coast in the Black Sea. The incident occurred 20 miles off the port of Trabzon, which is about 110 miles west of the Soviet-Turkish border. The Soviets arrested two of the trawlers; the other 10 returned to Turkey.

Malaysia's Minister of Law stated at a press conference in February that foreigh fishermen who are convicted of fishing in Malaysian waters with explosives will be sentenced to death under

EUROPEAN FISHERY MINISTERS LISTED

The NMFS International Fisheries Analysis Branch (F411), has prepared the following list of fisheries ministers and directors in western Europe.

Four independent fishery ministries exist in Denmark, Iceland, Ireland, and Norway. In Sweden, the National Board of Fisheries also functions independently. In the other countries, the officials responsible for fisheries are under different ministries, usually the Ministry of Agriculture, where their titles range from Minister of State and Under Secretary to Director General.

In Norway, there is a Ministry of Fisheries in Oslo which is in charge of overall policy and a Directorate General of Fisheries in Bergen which is responsible for the execution of these policies. There is also a Ministry of the Law of the Sea which deals with fishery problems related to LOS and extended jurisdiction.

In France, fisheries are under the Merchant Marine Ministry, which in turn is part of the Ministry of Transportation. A network of committees which are largely controlled by the Government, but include considerable participation from the fishing industry, are also important in decision-making in French fisheries. Fishery ministers and directors in western Europe are listed below.

West European Ministers of Fisheries (as of April 1977).

Belgium
Karel Michielson
Inspector in Chief—Director
Fishery Department
Ministry of Agriculture
Rue de Stassart 35
B-1050 Brussels, Belgium

Denmark
Svend Jacobson
Minister of Fisheries
Ministry of Fisheries
Borgergarde 16
1300 DK.K
Copenhagen, Denmark

Finland
Heikki Suomus
Department of Fisheries and Game
Ministry of Agriculture and Forestry
Hallituskatu 3
00170 Helsinki 17, Finland

France
Rene Thibaudau
Director of Maritime Fisheries
Secretariat General of the Merchant Marine
Secretary of State for Transportation
3 Place de Fontenoy
75007 Paris, France

Germany, Federal Rep. of
Gero Moecklinghoff
Ministerial Director
Ministry for Food, Agriculture & Forestry
Rochusstrasse 1, 53 Bonn
Fed. Rep. of Germany

Iceland
Matthias Bjarnason
Minister of Fisheries
Ministry of Fisheries
Lindarbae, Lindargata
Reykjavik, Iceland

Ireland
Patrick Donegan
Minister for Fisheries
22 Upper Merrion Street
Dublin 2, Ireland

Italy
Donato delli Bovi
Director General for Maritime Fishing
Ministry of the Merchant Marine
Viale Asia
00144 Rome, Italy

Netherlands
Ir. W.M. Otto
Director General for Fisheries
Ministry of Agriculture and Fisheries
Bezuidenhoutsewig 73
The Hague, Netherlands

Norway
Knut Vartdal
Director General of Norwegian Fisheries
Ministry of Fisheries
Raadstuplass 10
Postboks 185-186
5001 Bergen, Norway

Portugal
Pedro Amadeu de Campos Coelho
Secretary of State for Fisheries
Ministry of Agriculture and Fisheries
Rua do Ouro 181-1
Lisbon, Portugal

Spain
Victor Moro Rodriguez
Director General of Marine Fisheries
Ministry of Commerce
Ruiz de Alarcon 1
Madrid, Spain

Sweden
Lennart Hennarz
Director General
National Board of Fisheries
Fack, 403 10
Gotenburg, Sweden

United Kingdom
Julian G. Kelsey
Fisheries Secretary (Under Secretary)
Fisheries Department
Ministry of Agriculture, Fisheries and Food
Great Westminster House
Horseferry Road
London SWIP, 2AE, England

Malaysian law. Thailand's Foreign Minister issued a warning concerning Malaysia's intentions to all Thai fishermen on 24 February.

Cambodia seized a Thai fishing trawler on 28 February for violating Cambodian territorial waters. Two Thai crew members who jumped overboard and avoided arrest claim that the vessel was outside Cambodian waters at the time of seizure.

A Honduran newspaper accused the Nicaraguan Coast Guard on 5 March of firing on 13 Honduran fishing vessels and seizing three of them in Honduran waters. Nicaraguan authorities deny these charges and claim that the Honduran vessels were shrimping in Nicaraguan waters off Cayo Miskitos. The Honduran vessels were taken to El Bluff, paid fines and were released.

Indonesia siezed a 350-GRT Taiwanese fishing vessel for illegal operations in waters off West Irian on 5 March.

Cambodia seized two Thai fishing vessels in the Gulf of Thailand on 14 March.

The Uruguayan Navy seized the Brazilian fishing boat, the *Linda Mar,* on 18 March for reportedly fishing in Uruguayan-claimed waters. Three other Brazilian vessels escaped.

French Authorities in French Guiana have detained a Korean shrimp trawler under contract to a local shrimp processing company for allegedly operating within 12 miles of the coast. Authorities have reportedly removed $40,000 of shrimp in addition to fishing gear and equipment from the vessel.

The Venezuelan Coast Guard seized 10 Trinidadian fishing vessels, according to press reports of 5 April. The vessels were reportedly operating in Venezuelan territorial waters off the Amacuro Delta, 650 km east of Caracas.

Indonesia seized two Taiwanese fishing trawlers off the Moluccas on 21 April for illegal fishing in Indonesian-claimed waters.

Colombia released a seized Nicaraguan fishing vessel after paying of a 1 peso ($0.03) fine, according to press reports of 26 April. The vessel was seized by the Colombian Coast Guard in disputed Caribbean waters. A Nicaraguan newspaper suggested that the fine was a "clever move by Colombia," the payment of which "could be interpreted as a recognition of (Colombian) sovereignty. . . ."

Cambodia seized a Thai fishing trawler and its crew of 30 on 4 May. The Thai vessel was fishing in the Gulf of Thailand off Trat at the time of seizure, according to a Bangkok press account.

OTHER INCIDENTS

The net of a Japanese fishing boat operating in the Sea of Okhotsk became tangled in the bridge of a large Soviet submarine on 8 October 1976. The submarine surfaced and was cut free of the net by Soviet sailors.

Thailand warned its fishermen to stay out of Vietnamese-claimed waters after a Thai newspaper reported several Thai fishermen were killed and Thai vessels were sunk following recent violations off the Vietnamese coast.

Thailand's Fishery Association president stated on 11 January 1977, that Burma was holding about 200 Thai fishermen, Vietnam was holding 10 fishing vessels and some fishermen, and that an unknown number of Thai fishermen were being held in Cambodia.

A Soviet ship, resembling a trawler but thought by the Swedes to be a spy ship, moved into Swedish waters and went aground only 30 meters from the Swedish coast. The local press made much of the incident, describing sophisticated antennae and radar equipment. The Soviet crew refused Swedish assistance and the vessel was rescued by another Soviet ship on 16 February.

Two Swedish fishery reconnaissance vessels were subjected to close scrutiny on 15 February by two Soviet naval vessels in international waters in the Baltic Sea. The Soviets signalled the two vessels in an apparent attempt to bring them into the Soviet port of Klaipeda, Lithuania. The Swedes ignored the Soviet signals and left the area.

Indonesia has strengthened fisheries

PERU CLOSES ANCHOVY FISHERY

Peru's anchovy fishery was closed on 6 May at noon by official decree. The Instituto del Mar (IMARPE) had carried out exploratory fishing (which was actually limited commercial fishing) in March 1977. The results suggested that anchovy fishing should not be resumed until April.

Fishing was authorized to begin on 14 April to last from Monday through Friday in all fishing zones. After little more than 3 weeks, however, the fishery was closed on 6 May, except in the southern zone near Chile. The closure is based on recent IMARPE observations indicating that anchovy stocks are depleted. IMARPE had previously reported that climatic and oceanographic conditions in late 1976 would adversely affect anchovy fishing in 1977.

During 1977, the anchovy fishing in Peru has been open only 1-18 January and 14 April-6 May. Catches in 1977 had totaled less than 860,000 t, a decline of nearly 50 percent from the 1.7 million t caught during the first 4 months of 1976. Peruvian fish meal production through 6 May amounted to only about 197,000 t, a 46 percent decline from the 366,000 t produced during the first 4 months of 1976. The total supply of fish meal in Peruvian warehouses through 6 May was estimated at 369,400 t, including carryover stocks from the 1976 season of about 183,000 t.

The Peruvian Government maintained that the total 1977 anchovy catch would be about 4.5 million t. The U.S. Agricultural Attache in Lima, however, forecast that only about 2.5 to 3.0 million t would be caught in 1977. The Attache also believed that export contracts and domestic consumption needs would be covered through August 1977. It was hoped that fishing could resume in September or October.

IMARPE planned to conduct further exploratory fishing.

enforcement in its waters. According to the Indonesian press, more than 50 Taiwanese fishing vessels have been stopped or seized in waters near the Molucca Islands in the past 12 months.

Although Japan's House of Representatives approved on 10 May the ROK-Japan Continental Shelf Agreement of 1974, the future of this agreement is uncertain. The treaty must be approved by the Upper House of the Japanese Diet before the end of the current legislative session to take effect this year. The People's Republic of China made a diplomatic representation to Japan, noting that it was not a participant in the continental shelf talks and reserving its rights in the area.

Puerto Rico Hosts First Pan-American Fish Expo

The First Pan-American Fish Expo will be held in San Juan, Puerto Rico during April 1978, David Jackson, President of National Fisherman Expositions has announced. "The exposition will be designed specifically to meet the needs of the rapidly developing fisheries of the Caribbean, South America, and Central America," Jackson said. "Many of the countries of Latin America are looking to their marine resources to meet the growing need for protein. This has prompted a tremendous increase in the demand for the whole array of equipment and services associated with the commercial fishing industry. Pan-American Fish Expo will provide Latin American buyers with an opportunity to meet manufacturers and suppliers who can satisfy this demand for equipment and services."

Exhibitors from the United States, Europe, Latin America, and the Far East are being invited to participate. Manufacturers and suppliers of engines, vessels, electronic gear, nets, deck gear, propulsion equipment, processing and packaging machinery, pumps, clothing, and refrigeration equipment will participate. Visitors will include high-ranking personnel representing large fishing vessels or fleets of vessels, shipyards, packing and processing facilities, government agencies, and the banking and investment community.

Further information on Pan-American Fish Expo is available from L. William Bower, General Manager, National Fisherman Expositions, 21 Elm Street, Camden, Maine 04843, telephone (207) 236-4344.

Soviet Northeast Pacific Fish Catch Drops in 1976

The Soviet northeast Pacific catch in 1976 totalled 582,561 metric tons (t), a decrease of 29,110 t, or 4.8 percent, from the previous year. In 1975, the northeast Pacific fisheries contributed nearly 7 percent of the total Soviet marine catch of 8,932,203 t. In 1976, this percentage was somewhat lower due to reduced catches in the area and a greater global marine catch. (It is known that the Soviet total marine catch increased in 1976, but exact data are unavailable.) In each year, almost the entire catch was taken off the United States; the catch off the Canadian province of British Columbia was less than 1 percent of the area total.

The total annual catch for each species or species group with area subtotals is presented in Table 1. The heading "Western Alaska" denotes the Shumagin-Chirikof-Kodiak area and "Eastern Alaska" the Yakutat-Southeastern Alaska area (see map on following page).

The species heading "flounders" includes the arrowtooth flounder, Pacific black halibut, and all other flounders except Pacific halibut, which is listed separately. The category "rockfishes includes Pacific ocean perch and all other rockfish species.

Significant catch declines can be noted in the following areas for the indicated target species: Alaska pollock in the eastern Bering Sea and Aleutian area, rockfishes off western Alaska, and Atka mackerel off western Alaska. These reductions totalled 27,792 t, over 90 percent of the net decrease between 1975 and 1976.

In general, most Soviet northeast

Table 1.—USSR fisheries catch in the northeast Pacific in 1975 and 1976[1].

Species and Area	Catch (t) 1976	Catch (t) 1975	Percent 1976/1975[2]
Alaska pollock			
E. Bering Sea	209,142	216,567	96.6
Aleutians	3,673	12,262	30.0
Western Alaska	38,321	38,461	99.6
Eastern Alaska	711	1,488	47.8
Total	251,847	268,778	93.7
Pacific hake			
British Col.	3,870	3,493	110.8
Wash/Ore/Cal	152,340	155,405	98.0
Total	156,210	158,898	98.3
Pacific halibut			
E.Bering Sea	58	137	42.3
Aleutians	2	3	66.7
Western Alaska	26	50	52.0
Total	86	190	45.3
Flounders			
E. Bering Sea	38,931	40,187	96.9
Aleutians	315	228	138.2
Western Alaska	2,317	2,754	84.1
Eastern Alaska	110	12	916.7
Wash/Ore/Cal	145	151	96.0
Total	41,818	43,332	96.5
Rockfishes			
E. Bering Sea	18,941	16,465	115.0
Aleutians	7,216	8,147	88.6
Western Alaska	9,752	14,688	66.4
Eastern Alaska	136	383	35.5
British Col.	297	239	124.2
Wash/Ore/Cal	1,953	2,014	97.0
Total	38,295	41,936	91.3
Atka mackerel			
E. Bering Sea	1,006	1,248	80.6
Aleutians	12,120	12,078	100.3
Western Alaska	19,721	26,563	74.2
Eastern Alaska	311	1,213	25.6
Total	33,158	41,102	80.7
Sablefish[3]			
E. Bering Sea		38	
Aleutians		79	
Western Alaska		31	
Eastern Alaska		2	
British Col.		12	
Wash/Ore/Cal		68	
Total		230	
Cod			
E. Bering Sea	18,912	18,229	103.7
Aleutians	251	257	97.7
Western Alaska	1,852	2,535	73.1
Eastern Alaska	75	16	468.8
Total	21,090	21,037	100.2
Herring			
E. Bering Sea	17,073	14,201	120.2
All Other			
E. Bering Sea	13,982	12,314	113.5
Aleutians	493	178	277.0
Western Alaska	6,087	7,070	86.1
Eastern Alaska	159	199	79.9
British Col.	97	70	138.6
Wash/Ore/Cal	2,166	2,136	101.4
Total	22,984	21,967	104.6
Grand Total	582,561	611,671	95.2

[1]1975 data is final; 1976 data is preliminary.
[2]Data in this column are in percentages, not "total" figures.
[3]A separate sablefish category was not included in the source for 1976.
Source: VNIRO, Moscow.

Pacific fisheries yielded less in 1976 than in 1975. The cod and herring fisheries were the exceptions and of the two, only the herring catch rose by any appreciable amount, 2,872 t or 20 percent. There were several instances where large percentage increases or decreases occurred, but the quantitative changes were relatively small, i.e., less than 1,000 t.

The overall decrease in 1976 was the result of a combination of factors. First, overfishing of stocks in previous years decreased the productivity of many fisheries. Second, the expansion of the Soviet and other foreign fishing fleets and/or rising demands in foreign countries for fishery products increased competition for the available resources in the area. Third, the establishment of quotas under terms of bilateral agreements with the United States limited the Soviet catch of several species: Alaska pollock, 250,000 t; rockfishes, 24,500 t (excluding the eastern Bering Sea); and Pacific hake, 150,000 t. A quota for herring was also set through a bilateral agreement, but the catch ceiling of 30,000 t allowed for the recorded expansion of the fishery.

The Soviet 1977 catch in the northeast Pacific will be limited to 480,800 t under the terms of the Fishery Conservation and Management Act. The Soviet allocation figure represents a 17 percent reduction from the 1976 catch level and a 21 percent reduction from 1975. In terms of quantity, these reductions equal 101,800 t and 130,900 t, respectively. (Sources: All-Union Scientific Research Institute of Marine Fisheries and Oceanography (VNIRO), in Moscow; FAO, *Statistical Yearbook,* 1975; Pruter, A. T., "Soviet Fisheries for Bottomfish and Herring off the Pacific and Bering Sea Coasts of the United States"; IFR-77/74.)

Notes on Icelandic Fisheries[1]

Universal 200-mile fishery zones will probably cause substantial shifts in fish trading patterns. Iceland foresees the decline of the U.S. and Canadian import markets as the fishing fleets of those nations expand the utilization of fishery resources within their 200-mile zones. The EEC countries, on the other hand, are seen by the Icelanders as a growing market for fishery products. This is based on the belief that catches from the 200-mile zone of the EEC and the overexploited fishing grounds of the North Sea and the North Atlantic Ocean will not compensate for EEC distant-water catches within the jurisdiction of other countries. The Icelandic Government will therefore probably reach some sort of trade agreement with EEC allowing Icelandic fish exporters to set up a network to market fishery products in the EEC, similar to the one Iceland currently has in the United States.

The Government of Iceland announced on 13 April that it had agreed to resume fishery negotiations with the EEC sometime in late April or early May. There was no indication that Iceland was willing to grant new fishing concessions to foreign countries.

Iceland granted the Faroe Islands a capelin 1976/77 winter season catch quota of 25,000 metric tons (t) in exchange for the right to take an equal amount of blue whiting (a close relative of cod) in Faroese waters. The agreement was signed on 4 February 1977, in Reykjavik. Although 15 Faroese fishing vessels may fish inside the Icelandic fisheries zone, only eight may do so at the same time. The number of Icelandic vessels fishing for blue whiting during April-May 1977 (when fish migrate within the Faroese fisheries jurisdiction) was limited to 15. Both Governments agreed on the desirability of joint research on the blue whiting stocks within the fishery zone of both countries. In an earlier agreement, Iceland allowed Faroese vessels to catch up to 8,000 t of cod and 9,000 t of other demersal species within Iceland's fisheries zone during 1977.

The total gross registered tonnage of the Icelandic fleet increased by almost 3,000 t in 1976, and was 178,066 t as of 1 January 1977. This increase is due, however, entirely to the purchase of cargo vessels; fishing fleet tonnage decreased slightly during the same period. The Icelandic fishing fleet now ranks 19th among the fishing nations of the world accounting for 1 percent of the total world tonnage.

The annual repair bill for the Icelandic ocean-going fleet has been estimated by Minister of Industry Gunnar Thoroddsen at $24 million. This sum includes repairs to the fishing and merchant fleets as well as to a few naval patrol vessels. Nearly $9.5 million of this amount will be paid to shipyards outside Iceland.

Capelin and cod meal will be exported to Poland in record amounts in 1977. Several Icelandic firms have jointly contracted with Poland to supply

[1]The Branch of International Fisheries Analysis, Office of International Fisheries, NMFS, NOAA, which follows trends in world fisheries for the National Marine Fisheries Service (NMFS), prepared this short summary of developments in Icelandic fisheries. IFR-77/71.

12,300 t of capelin meal and 5,350 t of cod meal. The total value of the order is about $8.5 million. The all-time record sale will bring the Icelandic fish meal reduction plant capacity closer to full utilization. In addition, because the shipments were scheduled for early 1977, meal storage facilities had ample capacity when the capelin catch peaks later in the year. Fish meal was sold close to the prevailing world prices ($6.95 and $7.05 per protein unit for capelin and cod meal respectively), but the Polish buyer (probably the Rybex Export-Import Company) is paying the insurance costs. With the Polish contract, a total of 40,000 t of the expected Icelandic "winter fish meal" production had been sold. Iceland never before produced more than 60,000 t of "winter fish meal."

The Marketing Institute of Iceland's canning industry signed with the Soviet Union a record export contract for 10 million cans of spiced herring ("gaffalbitar"). This is the largest sale of canned fish in Iceland's history and the $4.2 million price is double the aggregate value of all Icelandic exports to the USSR during 1976. The contract will be executed by two Icelandic firms and will utilize from 10 to 15 percent of the total 15,000 barrels of salted herring produced in Iceland in 1976.

Two Icelandic exporters have jointly contracted to deliver 8,000 t of frozen fish fillets and 1,500 t of frozen whole fish to the Soviet concern Prodintorg, an importing firm of the Soviet Ministry of Foreign Trade. This large export shipment has a value of about $11 million.

Iceland exported dried cod, or stockfish, to Nigeria in March 1977. The stockfish was carried aboard four Icelandic freighters, and represented a portion of the large export sale of that product negotiated by an Icelandic trade mission in December 1976. Nigeria purchased the entire 1976 production of Icelandic stockfish and was expected to do the same in 1977.

Successful mink farming in Iceland may depend on proximity to a fish processing plant. Fish offal is a basic food for mink, an animal introduced in Iceland in the 1930's. Two mink farms near Reykjavik went out of business earlier this year, largely because of the high costs of transporting offal from the fish processing plants on the Reykjanes Peninsula. Another mink farm in Saudarkrokur, located near a fish processing plant, is doing well.

Iceland's Federation of Cooperative Societies announced that their U.S. subsidiary had a highly profitable year in 1976. The firm operates a plant which processes imported Icelandic frozen cod blocks into ready-made dinners and also imports frozen fish fillets which are usually sold directly to U.S. buyers. In 1976, the subsidiary's total sales volume in the U.S. was $48.5 million, 43 percent more than in 1975. High U.S. prices enabled the firm to sell frozen cod blocks for $0.90 per pound. They have invested about $4.6 million in their U.S. facility, which employs 240 people, including 5 Icelanders. The company also maintains an extensive distribution network in all but 2 of the 50 states and has about 1,200 regular customers.

Nigeria Adds Fish Production Project

Following the July 1975 change of Government in Nigeria, the Central Planning Office of the Federal Ministry of Economic Development reviewed Nigeria's Third National Plan for 1975-80. In keeping with the philosophy and priorities of the new government, emphasis in the plan was placed on such sectors as water, housing, agriculture, and health. The revised plan was not reviewed by the Joint Planning Board, the National Economic Advisory Council, nor by the Conference of Commissioners Responsible for Economic Development.

Both the Federal Government and the State Governments have fishery development programs. The Federal projects in the plan remain unchanged both in substance and in financial provisions, with the exception of one addition. This new project, entitled "Pilot Fish Production Project", involves the purchase of four modern fishing vessels to increase domestic fish production in Nigeria. This new addition has raised the original allocation for the Federal fishery program from US$93.7 million to US$95.3 million.

In the revised State fishery programs, extension services continue to be stressed. Fishermen cooperatives are to be formed and provided with facilities required for efficient and profitable operations. Other important features in the State programs include: loan schemes for indigenous fishermen, production and distribution of fingerlings, fish processing and distribution, development of river and pond fishing, coastal fishing, and shrimp trawling. The total allocation for the State fishery programs has been raised from US$68.9 million to US$72.0 million. The recent creation of several new States[1] made this increase necessary. (Source: Memorandum by the Central Planning Office, Federal Ministry of Economic Development, Lagos; IFR-77/95.)

According to the NMFS Office of International Fisheries, although, the Nigerian Government is interested in reducing excessive costs often resulting from the "consultant" services, the development of the Nigerian fisheries may present opportunities to the U.S. industry. As a result of the revision in the Third National Plan (1975-80), four new fishing vessels will be added at a cost of approximately US$1.6 million. A closer examination of the fisheries section of the original Third National Development Plan may reveal additional export opportunities in the areas of equipment or technology for aquaculture projects, artisanal and/or marine fishermen, and processing, marketing, or port facilities. Copies of this plan may be requested from the Country Marketing Manager, Central Western Africa, OIM/BIC, U.S. Department of Commerce, Washington, DC 20230.

[1] In March 1976, seven new States were created in Nigeria. The other 12 States were created in 1967.

Fishery Notes

Great Lakes Fish Stocking Hits New High

More than 26 million hatchery-reared fish were released in the Great Lakes and tributary waters during 1976 according to final planting statistics from the eight Great Lakes states and the Canadian Province of Ontario reports the *Great Lakes News Letter*. This record total is more than 2 million higher than was proposed at the time the planting schedules for 1976 were first reported. (The total excludes planting of eggs and fry, the initial growth stages.)

The principal species planted during 1976 were (in millions): lake trout 7.4, chinook salmon 6.7, and coho salmon 6.2; together they accounted for about 78 percent of the year's total. The record number of lake trout came primarily from federal hatcheries and their plantings were scheduled by the Great Lakes Fishery Commission which coordinates the lake trout rehabilitation program. Other species were reared and stocked by state and provincial agencies. Additional major species in the federal-state-provincial stocking programs were some 3.2 million rainbow trout and/or steelhead (lake-run rainbows) yearlings and fingerlings and over 1.7 million young brown trout. Other members of the trout-salmon family that were released in smaller quantities during the year were brook trout, splake (brook × lake trout hybrid), Atlantic salmon, and tiger trout (brook × brown trout hybrid). Other species planted in singular locations were fingerling saugers and muskellunge in the Sandusky Bay and Erie, Pa. sections, respectively, of Lake Erie, while more than 41 million herring fry from Minnesota hatchery facilities went into the western end of Lake Superior.

Lake Michigan waters received nearly half (47 percent) of the fish stocked in the Great Lakes during 1976, with releases of the principal species by the four bordering states totaling (in millions): chinook 3.4, coho 3.3, lake trout 2.6, rainbow/steelhead 1.8, and brown trout 1.0. For Lake Superior, about 3.0 million of the 4.5 million fish planted were lake trout, and most of the remainder were young coho, chinook, and rainbow, each having total releases in the 400,000 range.

Fish planting totals for the other lakes in 1976 were (in millions): Huron 3.8, Erie 3.5, and Ontario 2.1. Original stocking schedules for Lake Ontario were substantially reduced when traces of a chemical contaminant, Mirex, were found in the lake. As a result, the release of some of New York's supply of young lake trout and salmon was shifted to Lake Erie.

New Marine Traffic Rules Now in Effect

New International Rules of the Road for marine traffic took effect 15 July 1977 for all U.S. vessels on the high seas.

Appearing in the 31 March issue of the Federal Register, the 1972 International Collision Regulations replaced the 1960 International Rules. The new regulations were ratified by the United States last November.

"The 1972 International Collision Regulations are quite similar to the 1960 Rules, but in some specific cases significant changes have been made," said a Coast Guard spokesman. "Most notable of these are the provisions for 'early action' by the 'stand-on' (previously the 'privileged') vessel; new lights for vessels 'constrained by their draft'; new sound signals for vessels overtaking in a narrow channel; a requirement for 'safe speed' at all times to replace the old 'moderate speed' rule; and new emphasis on the duties and responsibilities of the lookout."

The International Collision Regulations include technical specifications for lights, shapes, and whistle signalling devices to replace the vague requirements of the 1960 Rules. A rulemaking document entitled "Alternative Compliance" and appearing in the same Federal Register specifies the manner by which vessels of special construction and purpose may, for the first time, be certified to deviate from these new international requirements.

As previously announced by the Commandant, the Coast Guard does not require vessels of less than 20 meters (65 feet) to be retrofited to meet the technical specifications of the new rules. Such vessels are acceptable if they are properly fitted and showing lights in general conformance with the requirements of the 1960 International Rules of the Road. Other technical specifications recognizing the limitations of smaller vessels but paralleling the requirements of the new Rules of the Road will be published later and will apply to vessels built after 1 August 1978, the start of model year 1979.

The Coast Guard publication "Rules of the Road, International-Inland", CG-169, has been revised to reflect the new International Rules of the Road and is available to the public through Coast Guard Marine Inspection Offices.

Planning the IDOE Future

The U.S. Program for the International Decade of Ocean Exploration (IDOE) will end as scheduled in 1980. Plans are now underway to design the ocean research program that will follow the IDOE. The goal will be to identify promising directions for marine research, their potential contributions to national ocean interests over the next 5-10 years, and the management approach most appropriate for carrying out these programs.

The basis for this planning effort will be four workshops in each of the major oceanographic disciplines: physical, biological, chemical, and geological. A final workshop, planned and organized by the National Academy of Sciences, will bring together the recommendations from these workshops and report them to the National Science Foundation in late 1977.

The Office for the IDOE invites the interest and participation of the scientific community in planning for the post-1980 program. Comments, recommendations, and requests for additional details may be sent to: Head, Office for the International Decade of Ocean Exploration, National Science Foundation, Washington, DC 20550.

NTIS Tells Foreign, U.S. Fisheries Reports

The U.S. Department of Commerce has received a number of reports on foreign fisheries and fishery markets. These items, listed below, are sold by the Sales Desk, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. Reports should be ordered by their NTIS Accession Number (checks should be made payable to NTIS).

The 7-page report entitled "Fish and Fish Products in Sweden" is divided into five parts: 1) regulation of fish imports; 2) Swedish imports of fish; 3) Swedish consumption of fish; 4) the government's fishery policies, especially as they relate to fishing limits; and 5) Swedish Coast Guard surveillance.

U.S. firms will be particularly interested in the first two parts, dealing with fishery import regulations and statistics. Current fees for importing fishery products into Sweden are 3 percent ad valorem, but may be revised at anytime. The importation of several species and commodities (cod, herring, salmon, shrimp, lobster, flatfish, haddock, hake, mackerel, and dried cod or stockfish) is subject to import licenses.

The figures on 1975 Swedish fishery imports show that they mostly come from the Scandinavian countries. The United States is a significant supplier only of salmon and, to a lesser degree, of shrimp. The U.S. Embassy in Stockholm prepared the report. A copy may be purchased for $3.50 by ordering document number DIB 77-05-015 from NTIS.

The U.S. Regional Fishery Attache for Africa, William B. Folsom, has prepared a 20-page report on Mauritanian fishery companies. The author briefly summarizes fisheries developments in 1974 and 1975 and then describes each company. The major activities of each company are detailed along with basic data on the company's processing plants and/or vessels.

Folsom also provides details on joint venture arrangements which Mauritanian fishery companies may have with foreign governments or companies. A copy of this report may be purchased (paper, $3.50; microfiche, $3.00) by ordering PB-261-862, "Fishery Companies of Mauritania," from NTIS.

The following reports on fisheries in various nations, prepared by U.S. diplomatic posts, are also available from NTIS. By country, title, DIB number, length, and cost, they are: Ecuador, "Fisheries," DIB 76-11-014, 14 pages, $3.50; Japan, "Direction of Technological Development," (Hatcheries and Stock Preservation), DIB 76-06-012, 21 pages, $3.50; Panama, "Fishing Industry," DIB 76-09-027, 26 pages, $4.00; Sweden, "Fishing Industry," DIB 76-02-002, 3 pages, $3.25, and "Fishing Industry," DIB 76-09-017, 7 pages, $3.50.

The growth of the Brazilian fishing industry has been limited by overfishing of some species. The government and industry groups are now paying greater attention to resource management and improved collection of statistical data. The government has attempted to aid the industry by financing fisheries research and providing financial incentives for fishing companies to expand their operations.

Brazil's principal exports are lobster, shrimp, sardines, and catfish. The total value of all fishery exports in 1975 increased 28 percent over 1974 exports. The United States is Brazil's major market for fishery products. In 1975, as much as 77 percent of all fishery exports were marketed in the United States.

Brazil's major import commodity is dried cod which is purchased principally in Norway and Portugal. U.S. manufacturers of fishing gear and equipment have not successfully entered the Brazilian market due to government import restrictions and a resistance on the part of Brazilian fishermen to use sophisticated modern equipment.

The U.S. Embassy in Brasilia has prepared a 16-page report on the Brazilian fishing industry. A copy of the report can be purchased for $3.50 by ordering document number DIB-77-03-004 from NTIS.

A list of U.S. processors and a list of U.S. wholesalers of fishery products have been compiled by the National Marine Fisheries Service. These lists give firm name, address, and major products handled by each firm. (Alaskan and Hawaiian firms are not included.) A duplicated copy of these lists may be purchased from NTIS. To order these lists use the following identifying symbols: PB-264-658—Processors, $7.50 per copy (179 pages); and PB-264-657—Wholesalers, $9.00 per copy (252 pages). A microfiche of each list is also available at $3.00 per copy.

SOVIET FISHERIES BOOKS TRANSLATED

Electrical Fishing: Theory and Practice, by V. Sternin, I. Nikonorov, and Yu. Bumeister, "Pishchevaia promyshlennost" Publishers, Moscow, 1972. This Russian book was translated in Israel under the auspices of the U.S.-Israel Binational Science Foundation.

The book is made up of two parts. The first part deals with the electric field of currents in electrical fishing. The subject matter includes electrical conductivity of natural waters, electrochemical phenomena on the surface of electrodes, electrical field of point and line current sources, electrical field of current between electrodes with simple geometric shapes, electrical conductivity between electrodes, and electrotechnical calculations for alternating and pulsating current. The second part deals with biotechnical foundations of electrical fishing. A limited number of free copies of this book and others, is available from the Language Services Branch, F412, Office of International Fisheries, NMFS, NOAA, Washington, DC 20235. Please request by accession (TT) number.

The books and their accession numbers are: TT 67-51267, "Engineering in Soviet fishery and fish processing" by N.P. Sysoev; TT 70-50164, "Adaptational features in fish ontogeny" by S.G. Soin; TT 70-54025, "Methods of continuous fishing" by I.V. Nikonorov; TT 71-50031, "Products from new ocean fish" by A.S. Lazunova and S.A. Lukoshkin; and TT 75-50005, "Electrical fishing: theory and practice" by Sternin, Nikonorov, and Bumeister.

Scotland Issues Annual Fishery Report, Tables

Scotland's Department of Agriculture and Fisheries has issued the "Fisheries of Scotland-Report for 1975" and a companion volume, "Scottish Sea Fisheries-Statistical Tables. The annual report is a 50-page text which analyzes the major causes for the disappointing results in the fishing industry in 1975 and includes short summaries of developments in the most important sectors of Scottish fisheries.

The introduction points out that 1975 was the first time in several years that fishermen's gross earnings showed a decline from the previous year. Rising costs, especially for fuel, cut deeply into profits and by mid-year forced the government to introduce a comprehensive program of subsidies to stabilize the fishing industry. The situation was particularly difficult for the distant-water trawler fleet; by the end of the year there was an actual reduction in the number of large Scottish trawlers operating on the high-seas. The depression affected Scotland's international trade in fishery products, and, during the year, Scottish fishermen even resorted to blockades to keep cheaper imported fish out of Scotland's ports.

The report summarizes Scotland's major fisheries, and devotes short chapters to whitefish (groundfish), herring, shellfish, and salmon. The role of conservation programs is explained, especially the impact of catch quotas set by NEAFC (Northeast Atlantic Fisheries Commission). There is also a discussion of the European Economic Community's fishery policies, particularly the establishment of producers' organizations, subsidies, and the introduction of withdrawal (minimum) prices, and their influence on Scottish fisheries.

Finally, the 1975 annual report contains short sections on other pertinent topics, such as harbor development plans and fishery research projects, and includes a statistical appendix and an organizational chart of the fisheries administration in the Department of Agriculture and Fisheries.

Those interested in purchasing copies of the report and the volume of statistical tables should write to Her Majesty's Stationery Office, 49 High Holborn, London WC1V 6HB, England. The purchase prices are £1.35 for "Scottish Sea Fisheries Statistical Tables" and 75p for the "Fisheries of Scotland-Report for 1975." At current exchange rates this amounts to about $3.60.

Fisheries Library Catalogs Printed

Publication of the "Catalogs of the Library of the Marine Biological Association of the United Kingdom," including a "Subject Index on Marine and Estuarine Pollution," has been announced by G.K. Hall & Co., Boston, Mass. The Library holds a comprehensive, worldwide collection of literature on marine biology, oceanography, fisheries, and related subjects.

The Library's Main Catalog consists of an alphabetical author/name listing and includes entries for the Library's extensive collection of expedition reports and its rare books section as well as for some 13,000 books, 40,000 bound volumes of periodicals, 1,450 current periodicals and serials, and over 50,000 reprints and pamphlets. Institutional entries are included in the Catalog and there are sections listing expeditions, bibliographies, and symposia proceedings. The Subject Catalog indexes books and monographs primarily, but also offers access to review-type papers of major interest.

Complete through June 1977, the "Subject Index on Marine and Estuarine Pollution" contains over 14,500 entries arranged into such groups as Environmental Conservation, General Water Pollution, Detection, Analysis, Removal, Specific Chemicals, Oil, Dispersants and Detergents, Metals, Pesticides, Radioactivity, PCB's, Domestic Sewage, Pulp and Paper, Food Processing Effluent, Heat, and Solids. Within each subdivision the references are arranged alphabetically by author.

The estimated 253,000 cards in the Main Catalog and the Subject Catalog, and the estimated 11,900 cards in the Subject Index on Marine and Estuarine Pollution have been reproduced by offset on acid-free paper with 21 cards per 10" x 14" page. There are 16 volumes in the Main Catalog and the Subject Catalog. The Pollution Index is a single volume.

In the United States and Great Britain, a complete set of the catalogs costs $990.00 (prepublication); they will cost $1,250.00 after 31 October 1977. Elsewhere, the set will cost $1,089.00 and $1,375.00, respectively. Separately, the Subject Index on Marine and Estuarine Pollution costs $75.00 in the United States and Great Britain (prepublication) and $95.00 after 31 October. Elsewhere it costs $82.50 and $104.50, respectively. Prices do not include shipping and handling.

In addition, the firm has published "Catalogs of the Scripps Institution of Oceanography Library," "Catalog of the Library of the Marine Biological Laboratory and the Woods Hole Oceanographic Institution," "Oceanographic Index," "Bibliography of Oysters and Other Marine Organisms Associated with Oyster Bottoms and Estuarine Ecology," and "Selected References to Literature on Marine Expeditions, 1700-1960," and others. Further information on the publications is available from G. K. Hall & Co., 70 Lincoln Street, Boston, MA 02111.

Vessel Safety, One-Man Trawl Activity Outlined

Two booklets, "Safety Notes for Alaskan Fishermen" (Marine Advisory Bulletin No. 3) and "Operation and Construction of the Plumb Staff Beam Trawl" (Marine Advisory Bulletin No. 4), both written by A.K. Larssen, have been published by the University of Alaska's Sea Grant Program.

"Safety Notes. . . " is a revised edition of a 1968 booklet which, owing to demand by both commercial fishermen and pleasure boat operators, went out of print in 1970. In the new edition, the chapter on weather and vessel icing has been completely rewritten and obsolete Coast Guard report forms have been updated. Weather forecast schedules, a time conversion table, a wind-chill factor chart, and other helpful charts and graphs are also included.

In its 120 pages, the booklet covers basic seamanship, Mother Nature, abandoning ship, survival, man overboard, first aid afloat, handling fishing gear and dos and don'ts, requirements of the law, inspections and maintenance, and marine engines.

The plumb staff beam trawl, which employs a detachable beam, is reported by Larssen to be an efficient method of small boat trawling. Photos and diagrams in the author's 17-page booklet give directions for building the trawl and handling the net. The plumb staff trawl is designed to be operated from a one-man boat equipped with a netreel, says Larssen, and, for the well appointed gillnet boat, it offers an excellent opportunity for a profitable one man fishing operation. Both publications are available through the University of Alaska Sea Grant Program's Marine Advisory Program, 3221 Providence Ave., Anchorage, AK 99504.

Fishing Industry Reports Listed For Nicaragua, El Salvador, Brazil, Mexico

The U.S. Embassy in Managua has prepared a report on the Nicaraguan market for imported fishery commodities. Nicaraguan exports of shrimp and lobster were over US$20 million in 1976; several million dollars worth of finfish were also exported.

Fishery imports have traditionally been less than $0.5 million annually. Nevertheless, Nicaragua could represent a steady, though small market for certain U.S. fishery products because: 1) there are no local canneries; and 2) only tropical fish species are available locally. Thus there is a market for nontropical fish and canned fish of all types. This market is limited, however, by the ample availability of fresh local fish, the high import duties on fish and fishery products, the low levels of income of most Nicaraguan consumers, and the traditionally low consumption of fishery products.

The Embassy's report contains information on import regulations, fishery imports by country and commodity for 1974 and 1975, import duties, and the economic stabilization tax. Data on fisheries consumption, fishing companies. and the fishing fleet are also reported.

El Salvador exports sizeable quantities of shrimp and some lobster, but is a net importer of other fishery commodities. During 1975, El Salvador imported over 1,400 metric tons (t) of processed seafoods, valued at $800,000, principally canned and cured fish. Imports provided about 16 percent of the 8,750 t of fishery products consumed in 1975.

While Salvadorian seafood consumption and imports have increased in recent years, preferential treatment of imports from Central American Common Market countries and Panama place U.S. exporters at a competitive disadvantage. Consequently, opportunities for U.S. exporters of fishery products are limited to high-quality specialty products (such as canned salmon) which are not produced in Central America.

The U.S. Embassy in San Salvador has prepared a detailed report on the Salvadorian market for fishery products. The report contains information on the best prospects for marketing U.S. fishery products, import and export trends, and the fisheries catch. Attached to the report are statistical tables, tariff information, Salvadorian regulations, lists of local fishery companies, exporters, importers, supermarkets, and information on fishery developments. The report, attached to IFR-77/84, is entitled "El Salvador—The Market for Processed Fish and Shellfish."

Brazil's Fisheries Development Program has published a complete registry of all Brazilian companies processing fishery products. The companies are listed by states and products (frozen, canned, salted, etc.).

An additional list of Brazilian fishing companies was published in the *Anuario da Pesca '76*. The list contains detailed information for some companies including the address, director's names, capitalization, assets, reserves, employees, affiliates, products, and quantity and value of production. The registry and list, attachments to IFR-77/104, can be obtained from the address given below.

The Regional Fisheries Attache for Latin America, Rolf Juhl, has prepared a brief summary of the present status of the Mexican fishing industry and the government's plans for future development. Fisheries represents only about 0.4 percent of Mexico's current gross national product and, with the exception of a few highly valuable species like shrimp, it is a marginal economic activity.

The government is interested in increasing the country's fisheries catch and has promoted the development of fisheries for species like anchovy which have not previously been fully utilized by Mexican fishermen. The government has also promoted the development of freshwater fisheries and aquaculture.

Juhl's summary describes the Mexican Government agencies involved with fisheries and the National Council for Science and Technology's recommendations to develop the country's fisheries. For additional details please request the report attached to IFR-77/34.

Each of the above items may be requested from the International Fisheries Analysis Branch, Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235 or from the NMFS Statistics and Market News Division offices in Boston, Mass.; New York, N.Y.; New Orleans, La.; Terminal Island, Calif.; and Seattle, Wash.

Tropical Atlantic-Pacific Climatic Atlas Published

Publication of the "Climatic Atlas of the Tropical Atlantic and Eastern Pacific Ocean," by Stefan Hastenrath and Peter J. Lamb, has been announced

by the University of Wisconsin, Madison. In its 97 full-page charts, the atlas presents a 60-year (base period, 1911-70) mean climatology, including details that may not appear on earlier charts but which appear essential for the understanding of low-altitude circulations.

The Atlas is divided into three sections: Kinematics and Dynamics (sea level pressure, resultant wind, directional steadiness of wind, divergence, vorticity, and curl of wind); Thermodynamics (sea surface temperature, sea-air temperature difference, specific humidity, total cloudiness, low clouds, precipitation frequency); and Climatic Variability (sea level pressure, resultant wind speed, sea surface temperature, total cloudiness). The atlas has been designed to provide a background climatology for students of meteorology, climatology, and oceanography, and for use in marine biology, commercial fisheries, etc. Wire bound, with stiff covers, the 9 x 17¾-inch atlas is available from the University of Wisconsin Press, Box 1379, Madison, WI 53701.

Catalogs List United Nations Fishery Books

As the exclusive distributor for FAO (Food and Agriculture Organization of the United Nations), UNESCO (United Nations Educational, Scientific, and Cultural Organization), and GATT (General Agreement on Tariffs and Trade) publications, Unipub makes their catalogs available. "FAO Books in Print 1976-77" is an 87-page catalog covering such topics as fisheries, land and water management and conservation, commodity production and marketing, animal science, food and nutrition, plant and crop science, farm management and rural development, and more. Titles are indexed by author and by subject.

"Publications of the General Agreement on Tariffs and Trade 1976" describes available titles of interest to the business, finance, marketing, and export/import community. Publications cover international trade by commodity, region, and country; trade in agricultural products; trade of developing countries, tariff structure, schedules, and protocols; and GATT-related decisions resolutions, recommendations, and reports.

Over 800 UNESCO publications of the United Nations Educational, Scientific and Cultural Organization (UNESCO) are described in the latest Unipub catalog. Included are all UNESCO books, periodicals, scientific maps, and slides.

Some 200 publications of international significance on all aspects of water resources are included in a new 24-page catalog available from Unipub. The list of organizations represented in this bibliography include the following agencies of the United Nations: FAO (Food and Agriculture Organization); IAEA (International Atomic Energy Agency); UNESCO (United Nations Educational, Scientific and Cultural Organization); and WMO (World Meteorological Organization); and such other international organizations as the International Development Research Centre and the Commonwealth Agricultural Bureaux.

Topics covered include: hydrology; meteorology; irrigation and drainage; water quality and pollution; resource development and management; economics and regulations; nuclear techniques; maps and atlases.

These catalogs are all available without charge from Unipub, Box 433, Murray Hill Station, New York, NY 10016.

Leaflets Note Danish, Mauritanian Fisheries

Foreign Fisheries Leaflet 76-2, "Fisheries of Denmark, 1975," has been prepared by the NMFS Branch of International Fisheries Analysis and is available for distribution. The 6-page leaflet contains information on landings, foreign trade, the reduction fishery, the Faroe Islands and Greenland, as well as a review of the industry's future prospects.

Another Foreign Fisheries Leaflet 76-3, "Fisheries of Mauritania, 1974," has also been published by the Branch of International Fisheries Analysis. The 35-page leaflet contains information on catch, artisanal and commercial fisheries, exports, the fisheries administration, research, foreign assistance, investment and sales opportunities for U.S. companies.

Foreign Fisheries Leaflet 76-4, "Mauritania's International Fishery Relations," is also available for distribution. The 7-page leaflet contains information on foreign fishing off Mauritania's coast and the fishery agreements which have been signed with Spain, France, Japan, the USSR, and over 20 other countries.

Copies of the above three leaflets can be requested from the Services Branch, D825, ESIC, NOAA, WSC4, U.S. Department of Commerce, 6009 Executive Blvd., Rockville, MD 20852. Please enclose two self-addressed labels to facilitate mailing.

FOREIGN FISHERY DATA AVAILABLE

The NMFS Office of International Fisheries has a limited supply of several previously issued "Foreign Fisheries Leaflets." Anyone interested in receiving a copy of the leaflets listed below may order them from the International Fisheries Analysis Branch (F411), Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235. Please enclose a self-addressed label to facilitate mailing. Requests will be honored as long as the supply lasts.

The leaflets include the following numbers: 74-9, Fisheries of Tanzania, 1972; 74-3, Fisheries of the Gambia, 1973; 75-1, Fisheries of Panama, 1973; 75-2, Fisheries of Denmark, 1974; and 76-1, Fisheries of the Malagasy Republic, 1974.

Also included are the following reports: Fisheries of the Republic of Korea, 1974; Persian Gulf Fisheries, 1969; The Commercial Shrimp Potential in West Africa Dakar to Douala, 1970; Japan's Fisheries, 1975; and Caribbean Spiny Lobster Fisheries Surveyed, 1976.

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